

**ENVIRONMENTAL SECURITY AND INFRASTRUCTURE IN
POLAND: IMPACTS FROM THE DEMISE OF THE FORMER
SOVIET UNION**



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Comments pertaining to this report are invited and should be forwarded to: Director, Institute for National Security Studies, HQ USAFA/DFE, 2354 Fairchild Drive, Suite 5D33, US Air Force Academy, Colorado Springs, CO 80840, 719-333-2717.

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By Samuel T. Ariaratnam, Ph.D., and Capt Laura M. Antalik (USAF)

1.0 INTRODUCTION

As the largest central European country that borders the Baltic Sea, Poland possesses a great amount of natural resources and a diverse landscape ranging from the “flat plains and gently rolling hills” which cover most of the country to the rugged mountains which form the southern boundary of Poland. As a country that formed part of the former Communist Bloc, Poland has had to endure a Communist form of government since the end of World War II. The fall of the Soviet Union has resulted in an increasing shift towards becoming a Democracy as evident by a large non-Communist victory during its first elections held in 1989. Although this shift toward democratization has resulted in improved social and political conditions, the Soviet legacy of unregulated industrial development and environmental neglect has left Poland a country with environmental problems it must deal with for many years to come.

Poland’s economy rests primarily on its industrial and agricultural production. Agriculture has formed the basis of Poland’s economy for hundreds of years. Since the Communist takeover after World War II, Poland’s economy has been increasingly shifting towards an industrial base. Today, industry accounts for roughly fifty percent of Poland’s gross national product (GNP) with agriculture accounting for about ten percent of the GNP. As a result, the percent of people living in urban areas has sharply risen from forty percent before World War II to over sixty percent today.

Poland possesses an abundant reserve of natural resources ranging from farmlands to mineral deposits. Farmlands cover roughly three-fifths of the land and require fertilizing due to poor existing soil conditions. Poland's forests cover one-fourth of the land. Poland stands second to France in having the largest variety of natural mineral deposits in Europe. These deposits include copper, lead, salt, silver, sulfur and zinc of which sulfur and salt serve a vital role in Poland's chemical industry.

Poland imports most of its crude oil because it possesses little petroleum reserve. As reported in the March 1994 edition of the *Oil & Gas Journal*, Poland has seven refineries which process about 12.5 million metric tons/year (250,000 barrels/day) of crude oil. This accounts for less than 1.5% of total oil consumption. To meet the rest of its petroleum demands, Poland imports about fifty-five percent of its crude oil from Iranian and British suppliers and forty-five percent through the Friendship pipeline system.

Poland also possesses one of the four richest hard coal and brown coal deposits in the world in its southern regions. In the early 1980s, Poland's recoverable coal reserves totaled about 43 billion tons, and the country was among the world's four largest producers of hard coal. Today, coal remains perhaps the most valuable natural resource Poland possesses.

This report provides an overview of current environmental conditions in Poland and addresses several key issues pertinent to environmental security. Several of the issues examined in this study include; the general state of the environment, current policies at several Polish industrial facilities, institutional capabilities for managing resources and issues, and potential situations of future conflict due to disagreements in the environmental arena.

2.0 OVERVIEW OF TYPES OF INDUSTRY AND INFRASTRUCTURE

As mentioned previously, industry contributes to the majority of Poland's GNP. The electromechanical, chemical, and power generating industries remain the current leading contributors to Poland's economy. Most of Poland's industries have developed around coal and mineral rich areas comprising over twenty distinguishable industrial districts. These districts occupy 18.5 percent of Poland's territory and house 48% of its inhabitants. The largest of these districts being the Upper Silesian Industrial District, the Warsaw Industrial District and the Lodz Industrial District. Following current world trends, shares of the raw materials branches of industry, namely fuel, metal-metallurgy, lumber and paper, are steadily decreasing.

For over forty years, Poland suffered just as much environmental damage as any other Eastern European country under Soviet rule. Investigations conducted in 1989 of Poland's environmental conditions revealed extensive damage to air, water, soil, and forest life. The damage was especially pronounced in the industrial districts of Upper Silesia and the areas surrounding Krakow. The photograph taken in 1985 of pollution emitted from a steelworks plant in Krakow stresses the magnitude of industrial pollution as illustrated in Figure 1. One observer, Glenn E. Curtis author of "Poland: A Country Study, 1994" noted that, "because the economy had depended for over forty years on unrestrained abuse of Poland's natural resources, environmental planners in the early 1990s faced the prospect of severe economic disruption if they abruptly curtailed the industrial practices causing pollution" (Curtis, 1994). Another observer noted, "the greatest concern is pollution's effects on human health, particularly its link with respiratory illnesses, bone disorders and terminal disease" (Dicks, 1995). Indeed, the heavy and unregulated industrialization of Poland has left scars on all aspects of its environment including air, water, soil and life.



Figure 1: Pollution from Steelworks Plant in Krakow, 1985

Poland's energy industry has continued to perform well during the country's transition out of Communism. Its electric power industry depends primarily on coal powered thermal plants because coal constitutes its most abundant natural energy resource. Air pollution resulting from the burning of this coal has reached disastrous levels. While under Communist rule, Poland did little to regulate the industry's pollution output rather choosing to focus on growth and industrial output. Air pollution has also resulted in serious respiratory problems to the people of Poland as well as extensive damage to the beauty of all of its national parks. Sulfur dioxide, a byproduct of burning brown coal, mixed with rain has resulted in problems with water pollution and acid rain.

Poland's pollution has created even more damage to its water than air. Studies conducted in the late 1980s and early 1990s revealed most of Poland's water to be unfit for any use whatsoever. Acid rain, industrial runoff, agricultural runoff and untreated sewage has left nearly all surface water polluted. With most of the rivers polluted there was virtually no potable water by US and European standards. In fact, a report released in 1990 revealed that ninety-five percent of the country's river water was considered undrinkable and that no river water was suitable for irrigation. The report also revealed that sixty-five percent of Poland's river water contained so much contaminants that it corroded industrial equipment (Curtis, 1994). Of this sixty-five percent, almost half was deemed absolutely unusable by industry.

Like all pollution, Poland's water pollution has not remained confined to the industrial areas. Runoff into the Vistula River has served as a major polluter of the Baltic Sea. Acid rain and runoff have damaged about half of Poland's lakes and acid rain has polluted a majority of the water, land, and life in all of Poland's national parks.

Pollution has also affected Poland's usable land and agriculture. Acid rain and improper land use had damaged nearly two-thirds of all forest land by 1990. Around 12,000 hectares of agricultural land had been declared permanently unfit for tillage because of industrial waste deposition. Lead and other heavy metals in the soil resulted in food from certain regions of Poland to be deemed unfit for human consumption. The photograph shown in Figure 2 reiterates the problem of industrial dumping resulting in pollution of the soil.



Figure 2: Industrial Dumping in Poland

The Upper Silesia region in south Poland, especially around the cities of Katowice and Krakow, serves as an example of the current state of Poland's environment. This high concentration of population and industry has resulted in a standard of living much below those of Poland's other regions and other comparable European cities. In 1991, Upper Silesia was designated as the worst of five official disaster areas in Poland. It was observed that public health indicators such as infant mortality, circulatory and respiratory disease, lead content in children's blood, and incidence of cancer were uniformly higher than in other parts of Poland and reported incidences of cancer were dramatically higher than indicators for Western Europe. Upper Silesia, sometimes called "Black Silesia", ranks as one of Europe's most crowded regions constituting 2.1 percent of Poland's total area, but containing about ten percent of its population (about four million people), and producing seventeen percent of the Gross Domestic Product.

Of the various cities in the Silesia region, Krakow and Katowice have the worst problems with pollution. Both cities continually experience declining life expectancies, rising incidences of leukemia, increasing infant mortality rates, increasing chronic illnesses requiring medical care for children under the age of ten, and below normal red blood cell counts despite high levels of carbon monoxide in those cities.

Krakow, the only Polish city to survive World War II unscathed, has turned into an official "ecological disaster area" due to its industrial fogs, acid rains and other pollutants harmful to humans, vegetation and buildings many of which are literally deteriorating. Krakow's level of pollution makes it one of the dirtiest and the most unhealthy non-Third World cities in the world. Its main sources of pollution include the burning of low grade fuel in crowded housing districts, uncontrolled factory air and waste pollution, and discharges from Krakow's increasing traffic population which includes cars with bad engines burning the unclean

fuel. From a distance Krakow looks quite appealing, however, many buildings and statues deteriorated due to air pollution, mainly acid rain. Today, many of these buildings and statues have been renovated through a restructuring program. Figures 3 and 4 show deteriorated (in 1986) and restored (in 1996) photographs, respectively of a statue at the Wawel Castle in Krakow.

In the past, the most identifiable source of air pollution in Krakow was the Nowa Huta Steelworks which was built on Stalin's orders in the early 1950s. Today, Nowa Huta, now renamed Sendzimira Huta, employs approximately 25,000 people and is arguably the largest steel mill in Poland. Regulatory compliances have resulted in major changes to the plant which now meets current environmental standards. Figures 5 and 6 are photographs of Sendzimira (Nowa) Huta in 1989 and 1996, respectively.

Katowice experiences pollution similar to Krakow. Much like Krakow, the region around Katowice has thrived under the unrestricted use of coal to power its industry and now faces the same problems with smog, acid rain, and dust that Krakow faces. However, unlike Krakow, the pollution in Katowice has had more impact on its people due to the close proximity of the sources. Among the contaminants discovered in a pond in Katowice was phenol, a toxic byproduct of steel production. This discovery is a clear indicator of unregulated industrial pollution. Katowice also has one of the highest sickness absence rates in Poland due to digestive tract diseases with lead levels in children being alarmingly high. Tests of virtually every farm and garden plot in the most heavily polluted parts of the Katowice region indicated that heavy metal



Figure 3: Deterioration of Statue at Wawel Castle in Krakow (1986)



Figure 4: State of Statue at Wawel Castle in Krakow (1996)



Figure 5: Pollution from Sendzimir (Nowa) Huta (1989)

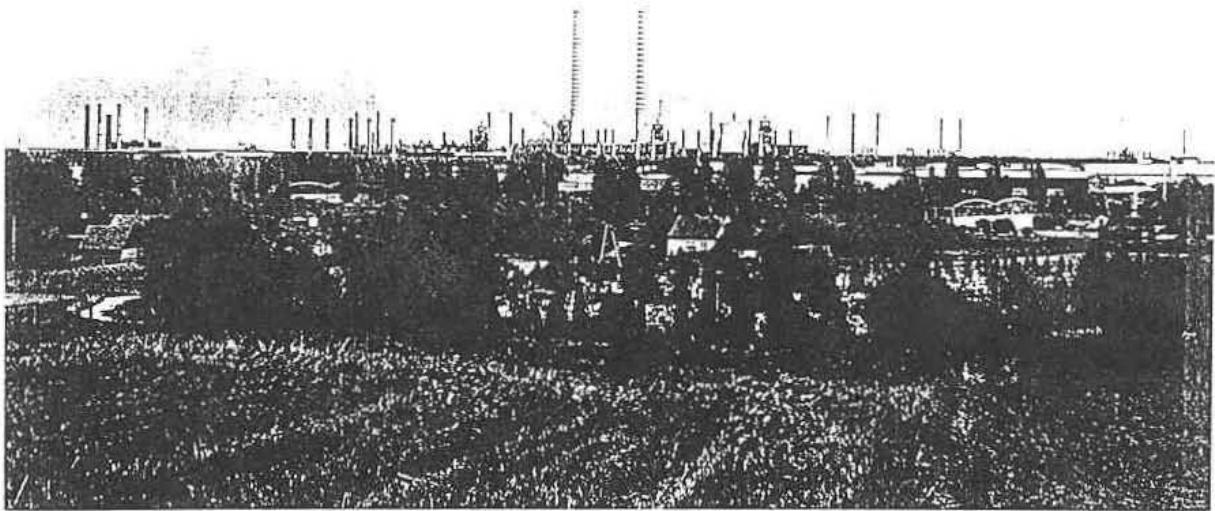


Figure 6: Sendzimir (Nowa) Huta (1996)

contamination made less than forty percent of the land fit for unrestricted cultivation of edible plants. Even so, about seventy percent of food consumed in the Katowice region is grown there. Katowice also faces a physical infrastructure problem due to the heavy coal mining that has exists in the area. Coal mines operating under Katowice suburbs have caused problems with shifting land and soil stability. One observer wrote, "In grimy Katowice suburbs, mines run under a large church with steel rods bracing internal columns to keep the roof from collapsing because of stresses caused by the shifting earth" (Hamilton, 1991).

The Soviet military presence in Poland during the Cold War was a major contributor to the problem of pollution. During its forty-six year occupation of Poland, the Soviet military allowed pollution of Polish bases to go uncontrolled. Uncontrolled fuel leakage, untreated sewage release, noise pollution from air bases, and widespread destruction of vegetation by heavy equipment were among the most serious conditions observed when inspections began in 1990. Today, experts concur that POL (Petroleum, Oil, Lubricant) deposits in the soil constitute the most severe environmental hazards. Prior to 1992, Poland demanded that the Soviet government pay fines and natural resource usage fees required by Polish law which they refused to pay. In 1992, the Poles dropped all demands to the Soviets for compensation as part of the withdrawal protocol.

Poland's public attitudes towards environmental problems appear split from the results of nationwide surveys taken in 1992. This division in perceptions may partially explain why Poland has not sensed an urgency to take large steps towards cleaning up its environment. According to that 1992 survey, only one percent of Poles cited the environment as being the country's most serious problem, although sixty-six percent rated environmental issues as being "very serious." By contrast, seventy-two percent cited economic issues as the country's most

serious problem. The old Communist social contract may partially explain the apathetic attitudes of those who see little problem with Poland's current environmental state. The old system dealt with the illnesses caused by pollution by treating the symptoms and not the causes. When workers got sick because of terrible occupational conditions, resources were devoted toward making their lives more tolerable. For example, most industrial plants in Upper Silesia contain spas in other parts of Poland where workers take regular vacations to escape the poor air. Instead of eliminating the causes of these illnesses, Polish employers often send their workers on vacations to cleaner environments as a reward for hard work. Some people do realize the severity of pollution, however, most do not know what can be done to alleviate the problem of pollution. Many Poles are cautious about getting help from Western nations for fear of becoming a mere scientific data point.

“Some Poles think of themselves as living in an enormous, open-air laboratory where the effects of the total environmental burden on humans are being tested.

Some people seem torn between wanting Western scientific attention, which could help them substantiate their suspicions and get action, and not wanting the dehumanization that comes with being a statistic or a subject in an experiment.

One group of physicians said quite explicitly, come help us to test, and we will give you unlimited access to subjects” (Fischhoff, 1991)

3.0 GENERAL STATE OF THE ENVIRONMENT

3.1 AIR

During the last 20 years, air pollution in Poland has reached a level that makes the country the third biggest polluter in Europe after the former Soviet Union and Germany. Compared with other European countries Poland has very high emissions of sulfur dioxide (SO_2) and particulates (Andrzejewski, 1993). Emissions per capita in 1992 were several times higher than most other countries due mainly to Poland's heavy reliance on coal combustion for electricity production and heating. Emissions of nitrogen oxides (NO_x) were similar to other European countries in 1992 although motor vehicle usage is much lower in Poland. Carbon dioxide (CO_2) emissions are the sixth largest in Europe because of high consumption of coal and high energy intensity. For these four substances, emissions in Poland decreased substantially between 1989 and 1994 (see Table 1 and Figures 7 and 8), SO_2 emissions by 33%, NO_x emissions by 25%, particulate emissions by 42% and CO_2 emissions by 20%.

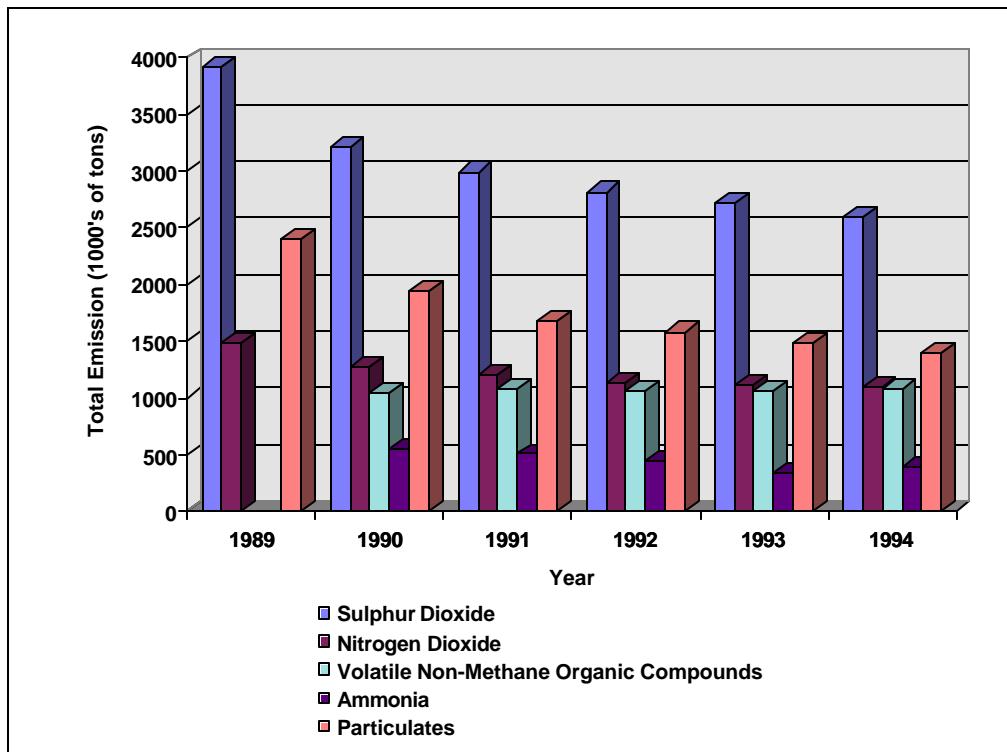
Air emissions occur predominantly in the highly industrialized urban areas. Six of the 49 voivodships (Polish townships) account for about half of the total air pollution emissions. The voivodship of Katowice in Upper Silesia covers only two percent of Poland's land area but accounted for approximately 20% of national particulate emissions and 23% of national SO_2 emissions in 1992 ... despite a 58% reduction in the voivodship's particulate emissions between 1989 and 1992 and a 45% reduction in SO_2 emissions (OECD, 1995).

According to recent studies, poor air quality is a serious threat to human health in the highly polluted areas of Poland. Air quality is worst in industrialized cities such as Chorzow in Upper Silesia, where average annual concentrations of several key pollutants are far above levels

	1989	1990	1991	1992	1993	1994
in thousands of tons						
Sulfur Dioxide	3910	3210	2995	2820	2725	2605
Nitrogen Dioxide	1480	1280	1205	1130	1120	1105
Carbon Dioxide	448,150	384000	388000	363000	372000	357000
Volatile Non-Methane Organic Compounds	n/a	1050	1086	1058	1058	1084
Ammonia	n/a	550	508	447	342	384
Particulates	2400	1950	1680	1580	1495	1395

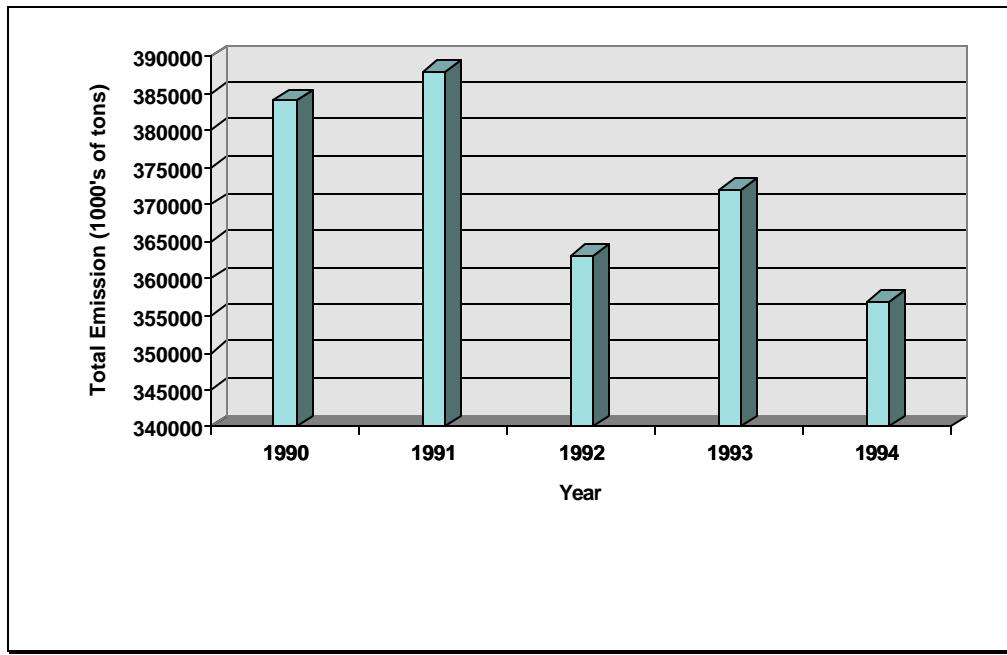
Source: Institute for Environmental Protection and the Ecological Institute of Industrialized Regions

Table 1: Total Emission of Main Air Pollutants



Source: Institute for Environmental Protection and the Ecological Institute of Industrialized Regions

Figure 7: Total Emission of Main Air Pollutants Excluding Carbon Dioxide

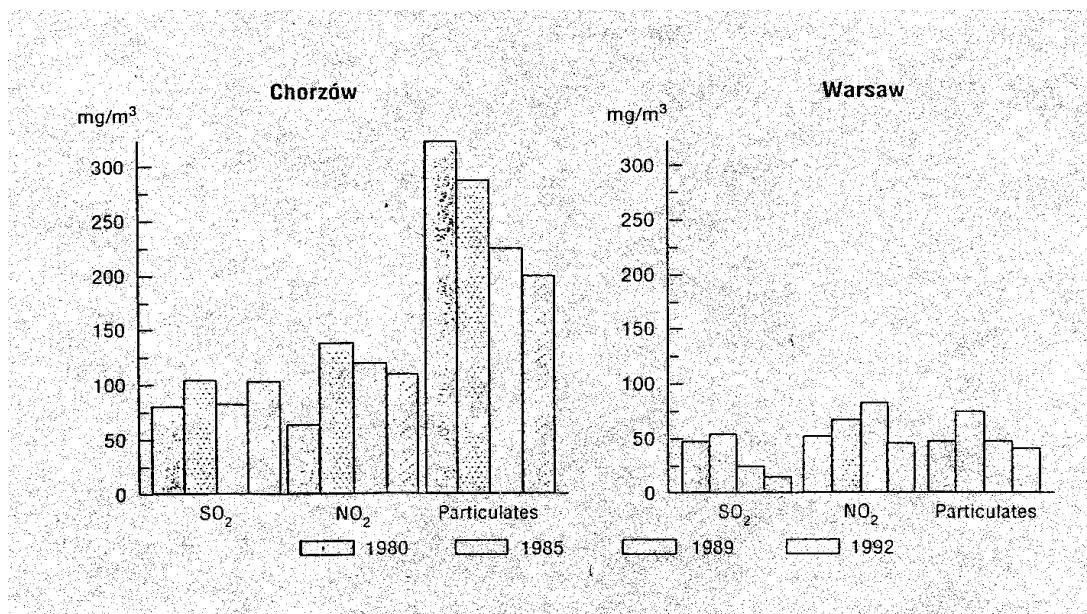


Source: Institute for Environmental Protection and the Ecological Institute of Industrialized Regions

Figure 8: Total Emission of Carbon Dioxide, 1990-94

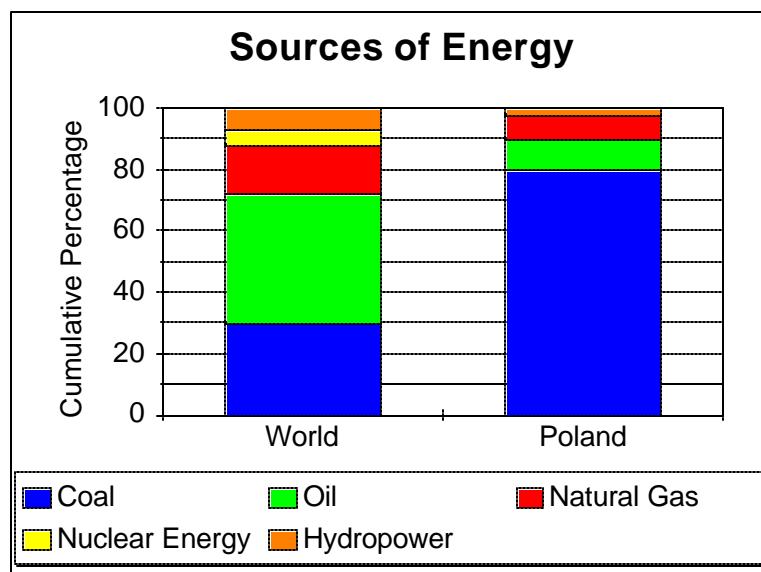
in Warsaw as shown in Figure 9. Polish cities have frequent episodes of high pollution when Polish air quality standards are exceeded. Data for 1990 to 1992 shows SO_2 concentrations which exceeded the standard (200 ug/m^3 , 24 hour limit) in 15 of the 49 voivodships. Particulate concentrations exceeded the standard (120 ug/m^3 , 24 hour limit) at measurement points in nearly all voivodships. NO_2 standards (150 ug/m^3 , 24 hour limit) were exceeded in eight voivodships.

Perhaps the greatest single cause of Poland's pollution problem is its inability to efficiently generate energy. Whereas the world currently uses coal, the dirtiest and most inefficient of modern fuels, for 30% of its energy supply, Poland utilizes it for over 80%. Furthermore, the majority of this coal is impure brown and bituminous coal, and measures are generally not taken to increase the fuel quality before burning to lessen the waste emitted as sulfur oxides and particulates.



Source: OECD Environmental Performance Reviews Poland, 1995

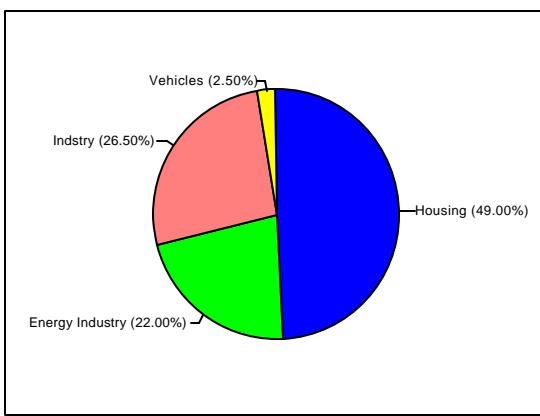
Figure 9: Urban Air Quality in Chorzow and Warsaw



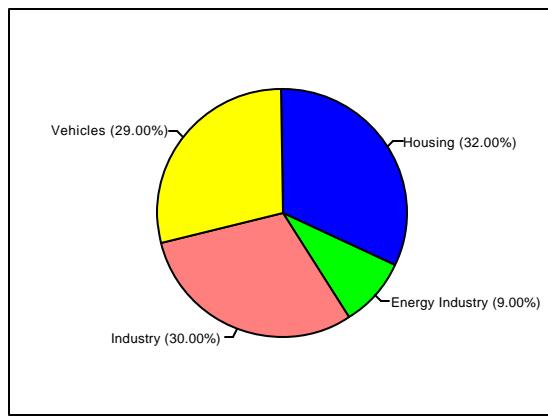
Source: Nowicki, Environment in Poland , 1993

Figure 10: Sources of Energy

In fact, coal burning accounts for over 90% of Poland's total sulfur dioxide emissions of 3 million tons per year. (Nowicki, 1993) In addition to nitrogen and sulfur oxides, Poland's heavy industry also outputs over 70% of all particulates in the country, which amounts to an additional 3 million tons of dangerous chemicals every year. (Nowicki, 1993) The Figures below indicate the approximate emission distribution for three major pollutants among the major Polish sources.



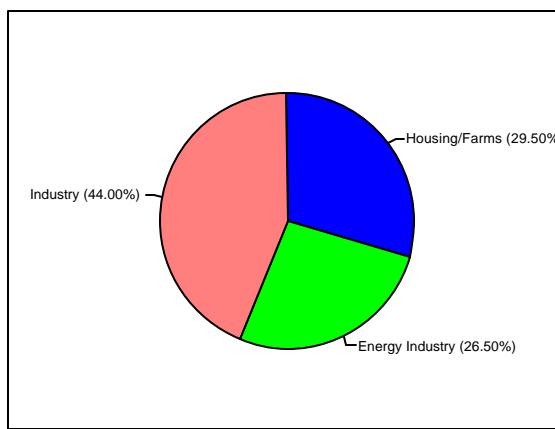
Source: Nowicki, Environment in Poland, 1993



Source: Nowicki, Environment in Poland, 1993

Figure 11 (a): Sulfur Dioxide Emission Sources

Figure 11 (b): Nitrogen Oxide Emission Sources



Source: Nowicki, Environment in Poland, 1993

Figure 11 (c): Particulate Emission Sources

3.1.1 Power and Industrial Sectors

1992 data indicates that the biggest source of emissions of all major pollutants continues to be the burning of fuel used to produce electricity, heat, and transportation. In 1992 power plants burning mostly hard brown coal generated 46% of Poland's total SO₂ emissions, 33% of NO_x emissions, and 27% of particulate emissions (OECD, 1995).

District heating plants and residential sector coal burning contributed 27% of SO₂ emissions and 33% of particulate emissions (OECD, 1995). "In Poland there are still about 8-9 million domestic furnaces which are used to heat apartments and about 1.5 million small boilers which deliver central heating to one or, at the most, a few buildings" (Andrzejewski, 1993). These sources are the most important contributors to local air pollution problems because they are usually concentrated in the densely populated centers of large cities. The emissions from their low (10-20 meter) smoke stacks are particularly dangerous because they remain concentrated in the urban areas, while those from the higher stacks of power plants are diffused over the countryside.

Industrial processes such as chemical plants, iron and steel mills, and zinc smelters are also a significant source of air pollution. Metal production released approximately 33,000 tonnes of metal-carrying dust in 1992, which was a serious health threat to people living in the vicinity of these plants. Despite the seemingly high dust emissions in 1992, this represents a 50% decrease from 1990 when 66,000 tonnes were generated by the mills. (OECD, 1995). The severe transformations of the political and economic system in Poland during the last six years have brought about a decrease in production for a significant number of industrial plants and factories. It has also resulted in a lowering of the demand for energy. A side effect of these

transformations is a decrease by as much as 25% of emissions of almost all atmospheric pollutants between 1989 and 1993 (Andrzejewski, 1993).

3.1.2 Transportation Sector

The transportation sector produces 25-35% of Poland's total emissions of CO, CO₂, NO_x, hydrocarbons, and lead. Road vehicles generate the overwhelming majority of transport sector emissions, and are a major source of noise pollution. The number of motor vehicles in Poland was once low compared to other European countries, but is growing rapidly as indicated below.

Transportation Means	Passenger's in percentage by kilometers			
	1988	1990	1995	2000
Individual cars	33.7	40.9	47.7	49.9
Railways	30.7	29.5	19.7	17.5
Buses	33.3	27.0	27.9	26.8
Aviation	2.3	2.6	4.7	5.8

Source: National Report to the First Conference of the Parties to the United Nations Framework Convention on Climate Change, 1994.

Table 2: Transportation Means - Passengers

Poland's freight transport by road has also increased substantially since 1989 despite the presence of an extensive rail network.

Goods transportation in percentage of tons by kilometers				
Transportation means	1988	1990	1995	2000
Roads	21.6	29.0	51.7	63.1
Railways	67.4	60.2	37.8	29.3
Inland Waters	0.8	0.8	0.6	0.6
Pipelines	10.2	10.0	9.9	7.0

Source: National Report to the First Conference of the Parties to the United Nations Framework Convention on Climate Change, 1994.

Table 3: Transportation Means - Goods

As the development of motorization continues, the problem of pollution in the centers of large cities by gasses emitted by vehicles will increase. This problem is particularly severe in the summer when, as a result of photo-chemical reactions, the nitrogen oxides and hydrocarbons emitted from cars, especially those running on badly tuned engines and burning inappropriate fuels, are transformed into a highly toxic, oxidizing smog. This vehicle induced air pollution is responsible for massive damage to the city of Krakow. The ornate stonework of old mansions and churches is rotting, plasterwork is crumbling, and metal roofs and cupolas are being eaten away. The damage became so severe that car traffic was completely eliminated in the city center. Evidence of the pollution damage (and subsequent restoration) to historical buildings can be seen in Figures 12 and 13.



Figure 12: Pollution Damage to Historical Buildings

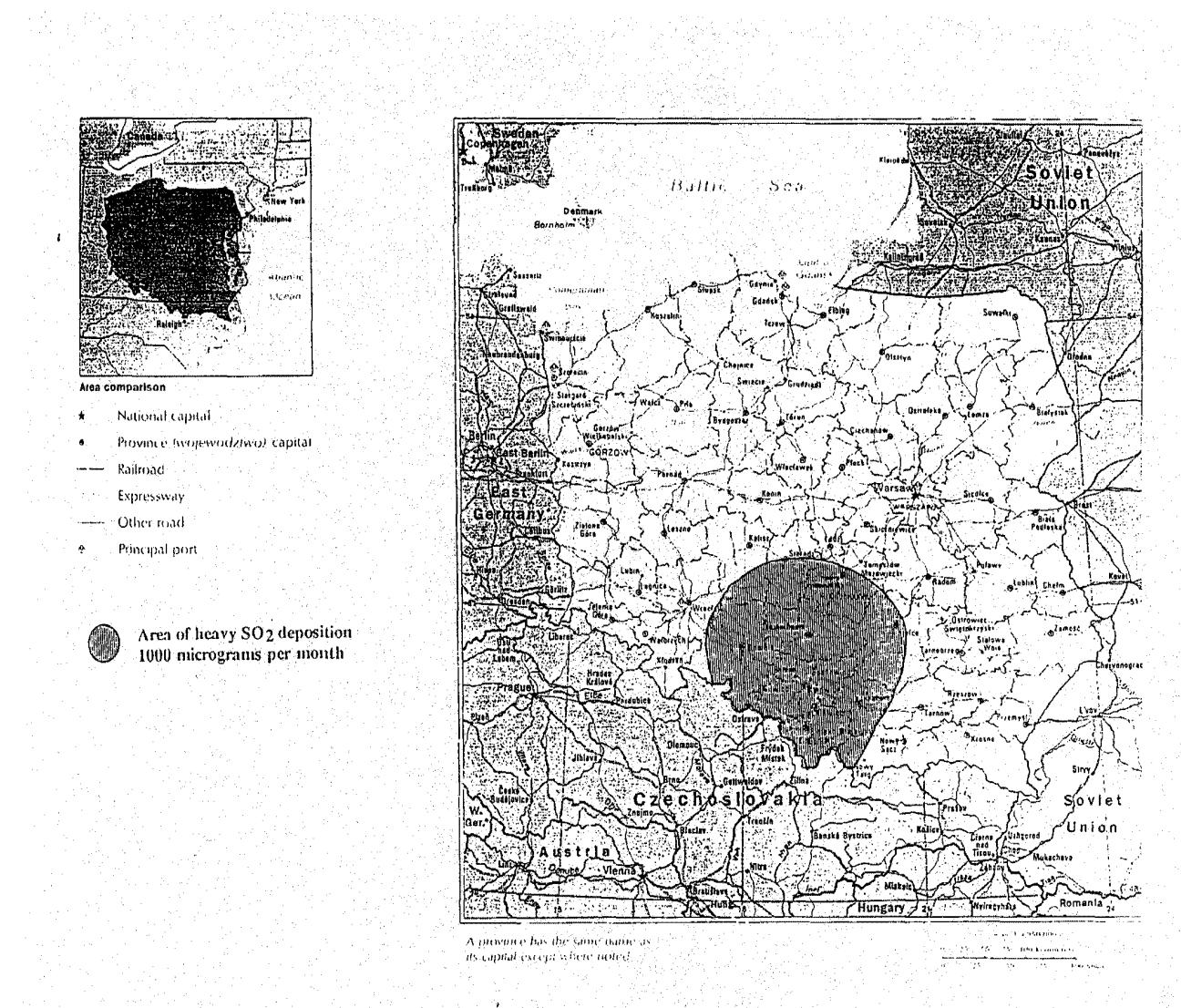


Figure 13: Restoration of Historical Buildings

The most effective way for Poland to reduce vehicular NO_x emissions is to require catalytic converters in all new automobiles (both foreign and domestic) which are introduced into the Polish market. The unleaded gasoline needed for cars with catalytic converters is readily available throughout Poland.

3.1.3 Acid Pollution Problems

Another problem related to the atmospheric pollution in Poland is acid pollution in the forms of smog and rain. The acid smog, created from the high concentrations of SO_2 , NO_x and dusts in the air during heating season in urban areas has caused a large threat to human health, and has resulted in sizable losses of private and state property such as the accelerated destruction of buildings, machines, and construction equipment. Acid smog occurs particularly often in Krakow and in some cities of Upper Silesia. Acid rain occurs in the southwestern part of the country, most heavily in the Izerskie and Karkonosze Mountains as illustrated in Figure 14. Precipitation in this area is characterized by the highest acidity in Europe. “On Sniezka Mountain the average annual acidity of precipitation reaches the level of pH 4.0-4.2, and there are cases of precipitation with a pH level below 3.0” (Andrzejewski, 1993). This precipitation severely acidifies the soil causing its degradation and the eventual destruction of Poland’s mountain forests. It is estimated that over 13,000 hectares of spruce forest have been totally destroyed by acid pollution. This is further captured in the photograph in Figure 15.



Source: Poland's Environmental Characteristics and Requirements, 1991

Figure 14: Concentrations of Acid Rain in Poland



Figure 15: Destruction of Forests by Pollution

3.1.4 Sulfur Dioxide Emissions

The reduction of SO₂ emissions is the most urgent air quality issue in Poland. Poland's national plan for SO₂ emissions reduction includes at least a 30% reduction by the year 2000 from 1988 levels, and at least 50-60% by the year 2010. The two areas where SO₂ emissions reductions will have the greatest effect on environmental quality are: the reduction of emissions from the power stations in Upper Silesia, which use bituminous coal and from the Turow and Belchatow power stations which use brown coal; and the elimination of individual coal fired home stoves and small boiler houses from the centers of all major towns. Both of these large expensive projects have begun. It was determined that the best way to reduce SO₂ emissions from Upper Silesian power stations is to improve the quality of the coal by desulphurizing it. This is being done for mines extracting coal with a sulfur content above 1.2%. Regulations issued by the Minister of Environmental Protection, Natural Resources and Forestry dated 12 February, 1990 banned combustion of this coal. Four mines extracting coal with high sulfur content were obligated to open coal desulphurization installations. The National Fund for Environmental Protection and Water Management contributed 30 million US dollars and the installations were built in 1991-1992. As a result, SO₂ emissions were reduced by about 100,000 tonnes annually, with a simultaneous 50-70% decrease in the ash content of the coal which brought additional economic, energy, and environmental benefits (Nowicki, 1993).

The bituminous coal quality improvement program alone is not enough to reduce SO₂ emissions to safe levels. Flue gas desulphurization (FGD) is also required for all the power stations that fire brown coal, in particular the Belchatow and Turow stations which are the two largest sources of SO₂ emissions in Poland. Because brown coal contains sulfur in its organic form, it cannot be separated from the fuel prior to combustion. The best way to capture the

sulfur is to install FGD scrubbers on all of the furnaces at these plants. In response to the serious environmental situation in Upper Silesia, there is a plan to retrofit all of the major power stations in the area with FGD units by 1998. The first installation of SO₂ removal equipment took place at the Rybnik power station in 1991. This is Polish technology implemented only by Polish contractors.

The various municipal and industrial coal fired boiler houses also need to be retrofitted with FGD units. There are some good efficient technologies available from Polish manufacturers which are usually cheaper than those offered by foreign contractors. The demand for these units has increased significantly in the past few years and is expected to continue.

Poland's next big challenge will be to meet the stringent standards for permissible SO₂ emissions which will come into effect in 1998. The requirements set forth in the regulations of the Minister of Environmental Protection, Natural Resources and Forestry in February 1990, cover SO₂, NO₂ and particulate emissions from any installation firing solid, liquid or gas fuels. It is estimated that full implementation of these requirements will reduce SO₂ emissions by 35-40% by 1998-2000, and by 60-70% by 2010, compared to 1988. The total cost of these measures will amount to about 3,000 million US dollars (Nowicki, 1993).

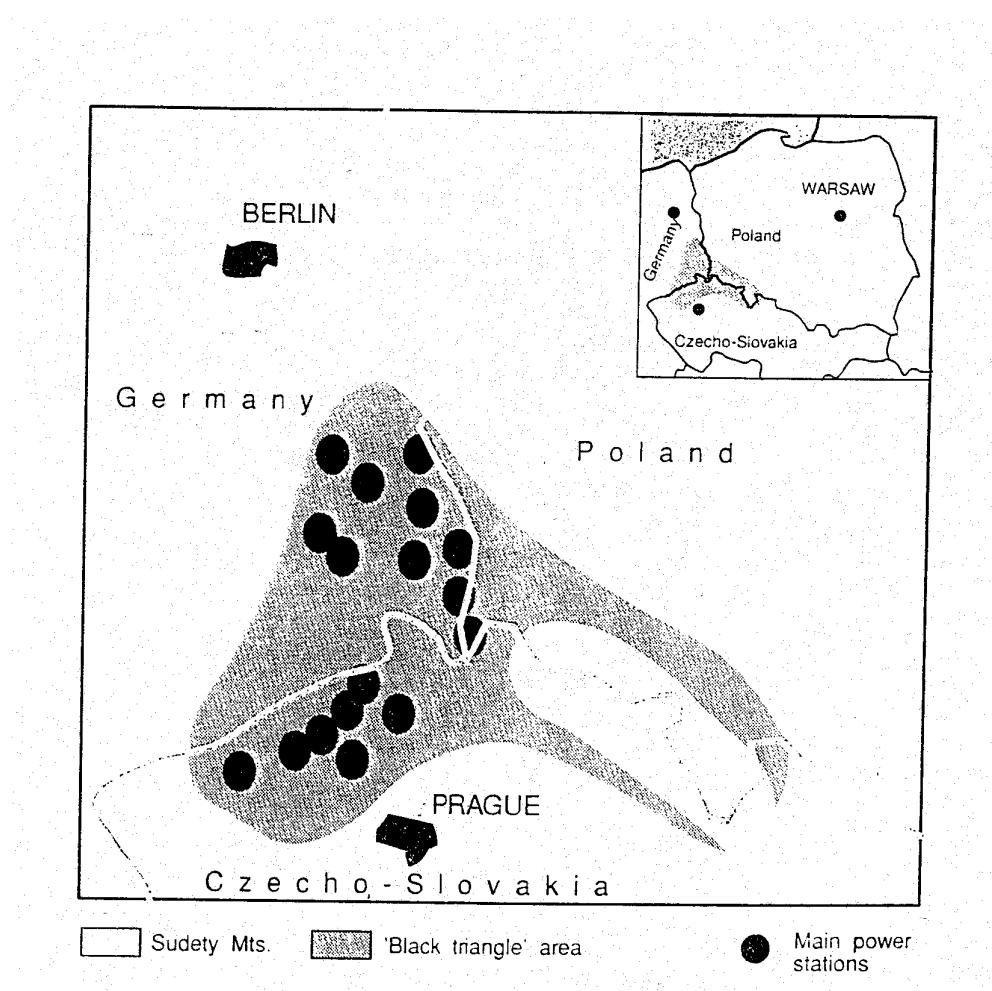
The U.S. Department of Energy is assisting Poland to meet the new emissions standards for sulfur with FGD technology. In November 1993 U.S. and Polish officials dedicated what they called "a showcase pollution control unit" that uses advanced U.S. technology and equipment at the Skawina Power Plant near Krakow (Seltzer, 1993). This FGD unit made Skawina the first power plant in Poland to be able to comply with the new pollution control laws enacted in 1990 which require a 43% cut in Skawina's overall sulfur emissions by 1998. The wet scrubbing unit was built by AirPol Inc. of Teterboro, New Jersey. The U.S. funded the cost

of the work, about \$7.8 million, under the Support for Eastern European Democracy Act of 1989. Poland plans to feature Skawina as a showcase facility for pollution control and will invite operators from other power plants to visit and observe the new technologies. It will also use the plant to test alternative coals.

3.1.5 Air Emissions in the "Black Triangle" Region - Southwest Poland

Europe's "Black Triangle" refers to the region which encompasses the common borders of Germany, the former Czechoslovakia, and Poland, and is generally considered to be one of the most heavily polluted areas in the world in terms of airborne particulates (see Figure 16). In fact, over 20% of all European sulfur emissions can be traced to this small region alone (Nowicki, 1993).

Although the Polish Sudety Mountain industrial region is not the sole source of the massive amounts of unsafe pollutants released into the air each day over Eastern Europe, it is a primary contributor. For example, in 1989 Poland received 84,000 tons of nitrogen oxides which originated in Germany and the Czech Republic and were transported by the prevailing easterly winds. However, at the same time Poland exported 144,700 tons to its neighbors, over 66% of which went to the former Soviet Union (Nowicki, 1993)



Source: Nowicki, Environment in Poland, 1993

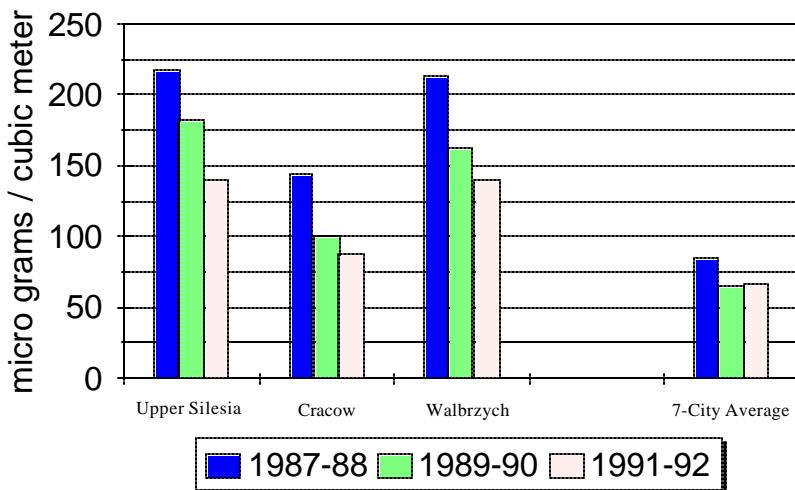
Figure 16: The “Black Triangle”

3.1.6 Air Emissions in Upper Silesia

The consequences of long term neglect of air pollution control is most apparent in the Upper Silesia region of Poland which is recognized as the second-most polluted area in the world behind the northwest corner of the Czech Republic. It is difficult to prove a direct correlation between Poland's excessive air pollution and the overall health of its inhabitants, but there are some alarming figures that are difficult to ignore. For example, Poland's life expectancy for women is 74 years, and only 66 years for men. This falls approximately three and five years below the European average, respectively (Nowicki, 1993). Furthermore, life expectancy for males has actually decreased by approximately 2.4 years since 1965 (Carter, 1993). While air pollution is probably not the only cause of health problems in the Upper Silesia region, the region boasts 50% more respiratory problems than the Polish average and is generally considered to claim one of the poorest health records in Europe. (Carter, 1993). Additionally, approximately 10% of all Polish land, inhabited by over 30% of the population, has been labeled environmentally hazardous. Three of Poland's most-polluted provinces, including Katowice, Krakow, and Walbrzych, are almost entirely environmentally unsound and air pollution is the cause of 46% of this damage (Nowicki, 1993). The following two Figures demonstrate the extensive air pollution in these regions as compared to the average pollution rate for the next-seven most polluted areas in Poland.

Particulate Deposits

Average Daily Amounts

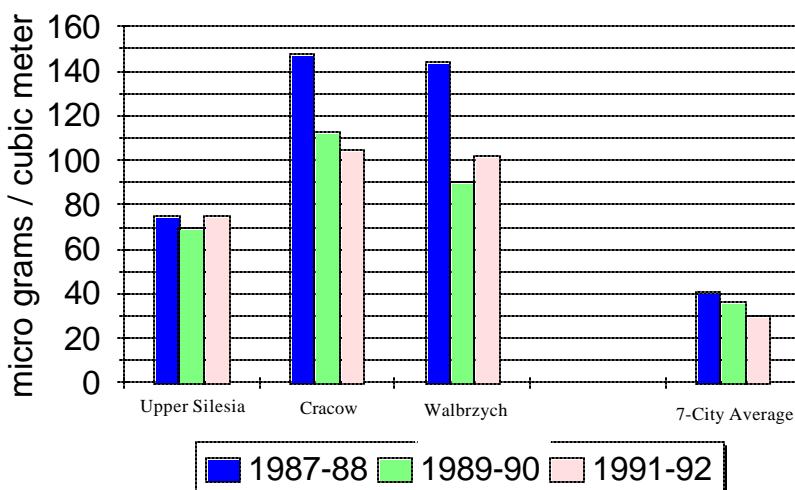


Source: Zanieczyszczenie Powietrza w Polsce, 1993

Figure 17: Average Daily Particulate and Dust Deposits (mm/m³)

Sulfur Oxide Deposits

Average Daily Amounts



Source: Zanieczyszczenie Powietrza w Polsce, 1993

Figure 18: Average Daily Sulfur Oxide (SO/SO₂) Deposits (mm/m³)

3.1.7 Past, Present and Future Initiatives to Reduce Air Pollution

The city of Krakow, represented in recent years as the darkest spot on maps showing environmental threats to the European continent has been particularly aggressive in its fight to reduce dangerous air pollution levels. Specific examples are as follows: (Bolek, 1992)

- discontinuation of vitamin C production which was damaging to the environment;
- closing down of harmful boiler house at POLFA Pharmaceutical Works in Krakow;
- closing down of obsolete production plants at the T. Sendzimir Steelworks which had the strongest impact on the environment;
- replacement of two obsolete electro-filters at SKAWINA Power Plant;
- modernization of dust control systems at NOWA HUTA Cement Plant;
- replacement of one of the electro-filters at the T. Sendzimir Steelworks Power Station;
- closing down of the coal-fired boiler house at Tobacco Factory in Krakow;
- closing down of a considerable number of municipal coal-fired boiler houses;
- building of a ring road to direct traffic outside the city center.

As part of the “*National Environmental Policy Implementation Program Through the Year 2000*” which was adopted in 1995, Poland plans to take the following measures to improve air quality:

FOR STATIONARY SOURCES:

- continued improvement of coal quality with desulphurization and coal-fines preparation;
- modernization of combustion techniques in coal-fired power stations and conversion to modern environmentally friendly techniques such as fluidized bed combustion or low-NO_x burners;
- restructuring of production processes in different industrial sectors;
- construction of facilities and installations for particulate control and flue gas desulphurization;
- optimization of heating systems in existing and newly built plants;
- elimination of low altitude emissions by converting domestic furnaces from coal to gas;
- use of renewable energy sources (geothermal, wind, etc.);
- improvement of existing legal, economic and other instruments such as updating the “List of 80” (80 most polluting enterprises as listed in Appendix A), provincial lists which contain around 800 enterprises, development of Environmental Impact Assessment procedures, and performance of environmental audits connected with the privatization process.

FOR THE TRANSPORTATION SECTOR:

- a ban on the registration of new cars without catalytic converters (except for cars with engine capacity below 700 cm³) [implemented in July 1995];
- introduction of fuel-injection devices and multi-function catalytic converters in engines with spark ignition [in progress];
- modernization of engines with self-ignition and adjustment to the requirements of UN-ECE regulation No. 49.02 [1998];
- replacement of old engines with imported engines in cases where modernization is not justified from an economic point of view [in progress];
- conversion of some mobile sources to gas fuel [in progress];
- launching production of catalytic converters and filters [in progress];
- elimination of asbestos from the production of brakes and spare brake parts [1991-1998];
- removal of old trams and modernization of the remaining ones [in progress];

- construction of fast local transport systems such as a regional railway in Silesia, fast trams in Poznan, and the underground in Warsaw;
- development of intercity rail connections and modernization of basic railways;
- construction of modern highways, express roads and bypasses around city centers;
- development of infrastructure for bicycles;
- replacement of buses that do not meet UN-ECE regulation No. 49.02;
- replacement of old passenger planes;
- production of new tram rails with reduced vibrations;
- maintenance work on tram rails;
- launching production of light acoustic absorbers and installing them near transportation routes;
- replacement of windows in buildings that are situated in areas exposed to excessive noise;
- increase production of unleaded petrol and decrease sulfur content in diesel fuel [1998];
- have available and use fuel additives that lower pollution emissions.

3.1.8 Meeting International Standards

Poland is eager to harmonize its environmental standards with those of Western Europe. The entire country is undergoing changes in order to achieve compliance with the Sulfur Protocol to the Geneva Convention and UN-ECE regulations on vehicle emissions, certifications of monitoring equipment at inspection stations, and certification of all aircraft in use for compliance with noise requirements. Additionally, Poland signed on to the United Nations Framework Convention on Climate Change during the United Nations Conference on “Environment and Development” in Rio de Janeiro in 1992. By signing this document Poland obligated itself to stabilize greenhouse gas emissions by the year 2000 on the levels of 1988. Lowered energy consumption, the elimination of coal use in households and small plants, and

waste re-use programs have already contributed to significant reductions in greenhouse gas emissions, especially carbon dioxide.

3.1.9 What Should Be Done?

Clearly, Poland's air pollution problems are deeply rooted within the country's economic and social infrastructure, and changing such institutions will take years and cost a tremendous amount of money, not to mention inconvenience the entire nation until it is able to adapt to and utilize energy in a completely different manner. Despite the difficulty in converting the economy to more efficient fuel sources, though, the long-term problems that could be alleviated by doing so will more than compensate for the trouble of incorporating these new procedures. In fact, if Poland expects to emerge as a viable economic power on an international scale, these changes are not only beneficial, but absolutely imperative.

3.2 WATER

3.2.1 Utilization of Water Resources

Poland is poorly endowed with freshwater resources. Available water resources amount to approximately 1500 cubic meters per person per year, which is one of the lowest ratios in Europe (OECD, 1995). This is mainly due to fairly low precipitation, irregular geographical distribution of water resources, and high percentages of leakage and waste in industries and households. The main user of Poland's water is industry which accounts for about two-thirds of all utilization. The municipal sector uses about 60% of the remaining third, and agriculture and forestry use the other 40% (see Table 4 below).

Water Intake (km ³ /year)	1980	1985	1990	1991
Total	14.18	15.45	14.25	13.27
Industry	10.14	10.92	9.55	8.88
Municipal	2.72	2.93	3.00	2.87
Agriculture and Forestry	1.32	1.61	1.69	1.52

Source: State of Environment in Poland, Warsaw, 1993.

Table 4: Water Consumption by Sector

The largest demand for water comes from the power generating industry. It requires 77% of all industrial water and 52% of the total consumption.

Over 84% of the water Poland uses comes from surface waters, 14% comes from underground sources, and about 2% from mine discharges (Andrzejewski, 1993). The fishing industry uses a significant portion of the surface water since fish occur naturally in 85% of the reservoirs, lakes, and rivers.

Most towns in Poland have their own potable water supply systems based on local intake of underground water from drilled wells or from local surface waters. Treatment facilities vary from no treatment to modern treatment plants such as the Northern Water Treatment Plant in Wieliszew. Nearly all 24 million urban residents are connected to public water supplies, and the quality of the piped drinking water is satisfactory for at least 90% of them. Only 24% of the

rural inhabitants have a piped water supply (OECD, 1995). Excessive levels of nitrates in shallow wells is a widespread problem in rural areas.

3.2.2 Causes of Water Pollution

Municipal sewage and industrial wastes have the biggest impact on water pollution. Out of 720 towns with sewer systems, in 1990 only 467 had any kind of sewage treatment works. In 1994, about 42% of sewage received secondary biological treatment and met requirements, 32% received inadequate primary mechanical treatment, and the remaining 26% of the total amount of sewage was discharged into rivers, lakes, or the Baltic Sea without any treatment (Eurostat 1996). Although more than 1500 treatment plants were completed between 1990-1994, still almost half of the wastewater producing industrial factories and 32% of Polish cities do not have access to them. Many of the facilities that do exist are old and worn out or have insufficient flow capacity for the populations they serve.

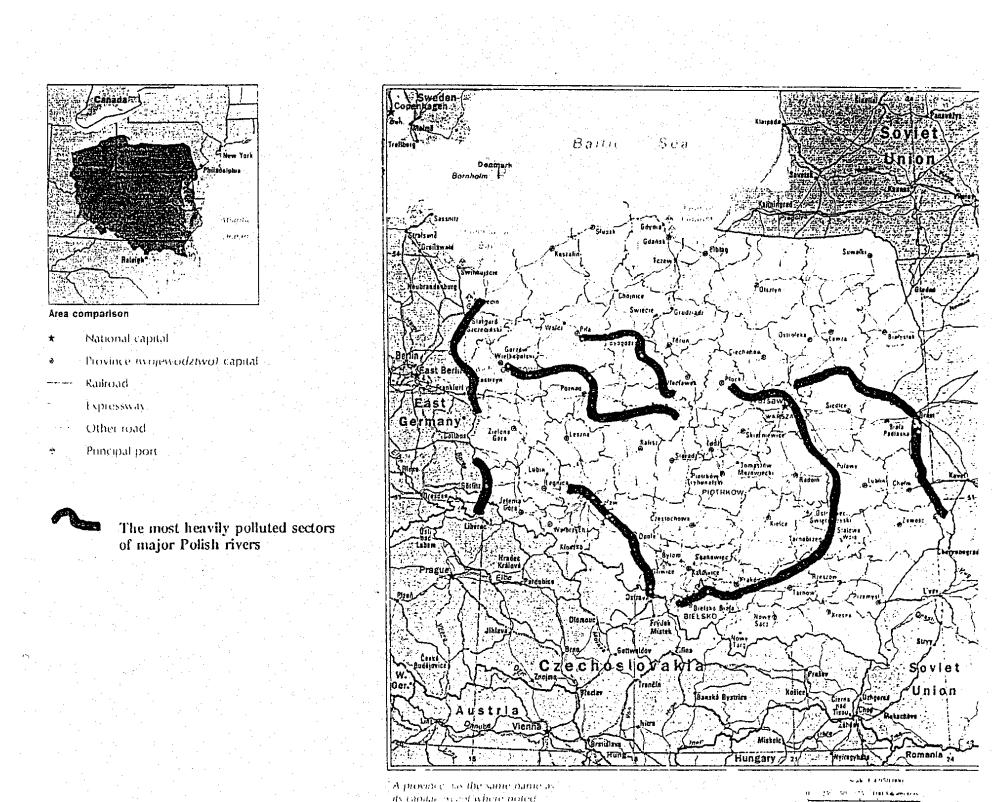
The estimated average share of industrial effluents in municipal sewage is about 30%, and in some industrial towns as high as 80%. The majority of the factories and plants do not pre-treat their effluent before it is discharged into the sewer system. Because of this, large quantities of chemicals, heavy metals, petroleum products, and other industrial pollutants end up at the municipal waste water treatment plants. The high toxin concentrations in the waste water often prevent the use of biological sewage treatment methods because the pollutants kill the helpful microorganisms.

Another problem stems from the bituminous coal mines in Upper Silesia. The mining process produces large amounts of water with very high saline content which is dumped on a

daily basis into the Vistula and Odra rivers. The total load of salt discharged from mines is estimated at about three million tons per year (Nowicki, 1993). Aside from causing a huge amount of river pollution, the saline waters have caused heavy damage to heating systems in towns located along these two rivers and to many industrial plants which use the river water as a coolant.

As a result of the past lack of treatment before final discharge the quality of most of the Polish rivers is very poor. In 1994 only 8% of the country's river water was potable and approximately 35% of the water was so polluted it was even unusable for industrial purposes. Figure 19 shows the most heavily polluted sectors of rivers in Poland. Most Polish lakes have also been severely polluted. Of 161 large lakes tested for water quality, only 4 qualified for the highest purity class, and 63 lakes had water unsuitable for drinking or recreational purposes.

Pollution of groundwater by municipal sewage, fertilizers, pesticides, petroleum products, and salt used to de-ice roads is also widespread. In 1994, contaminated groundwater was confirmed in 17% of local and farm water-lines, in 40% of public wells, and in 59% of private wells investigated by the Sanitary Inspection Service (Eurostat, 1996). The main source of residential well pollution is community sewage. Another source of groundwater pollution at various locations around the country is the former Soviet Army. High levels of petroleum contamination have been found at several former Soviet bases. Table 5 and Figures 20 and 21



Source: Poland's Environmental Characteristics and Requirement, 1991

Figure 19: Sectors of the Most Heavily Polluted Rivers

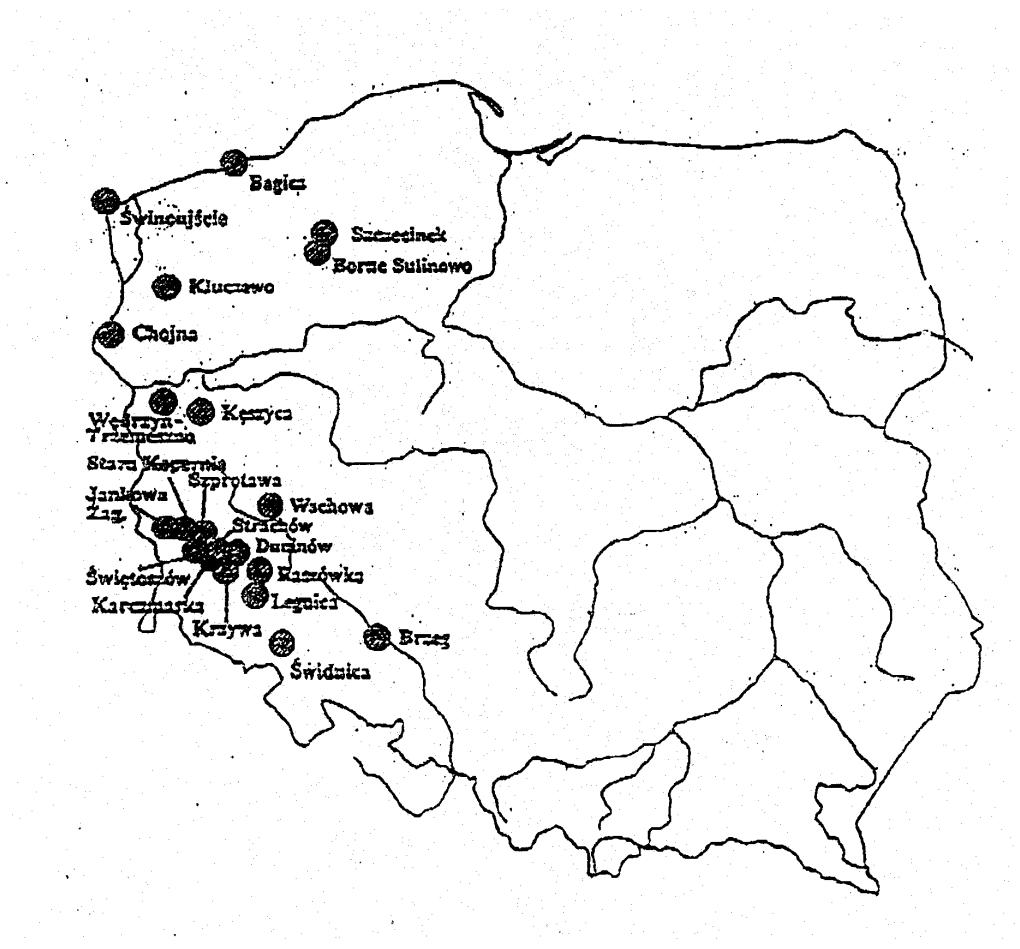
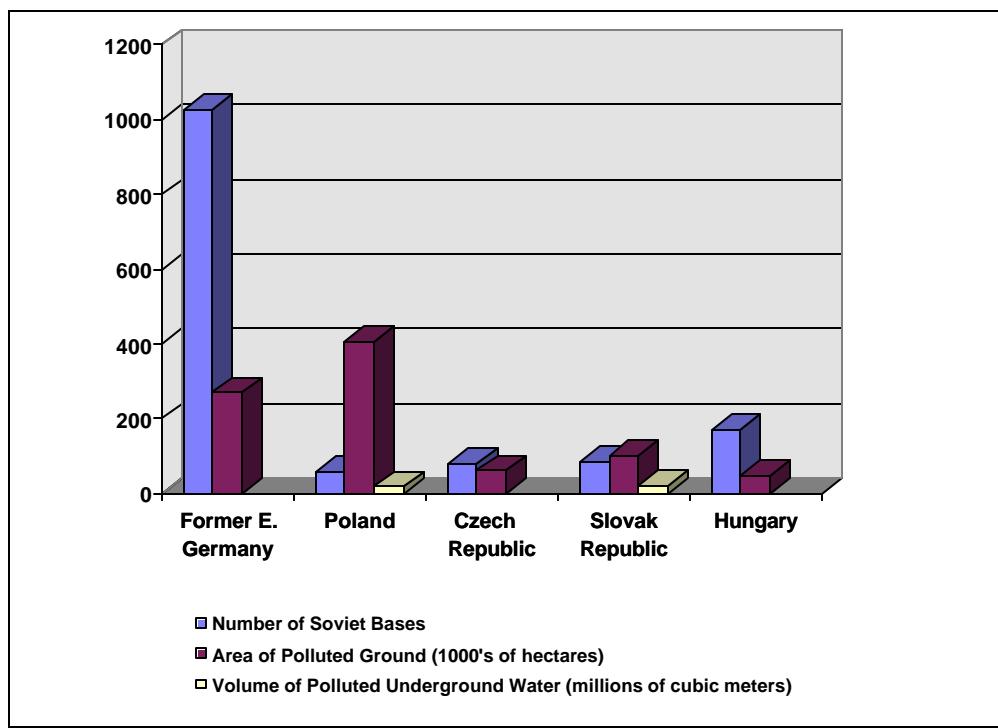


Figure 20: Locations of Former Soviet Defense Sites in Poland

COUNTRY	NUMBER OF SOVIET BASES	AREA OF POLLUTED GROUND (thousands of hectares)	VOLUME OF POLLUTED UNDERGROUND WATER (millions of m ³)
Former East Germany	1026	270	N/A
Poland	59	406	18
Czech Republic	80	60	N/A
Slovak Republic	87	70-100	20
Hungary	170	48	N/A

Table 5: State of Underground Water and Soil Pollution Left From Former Soviet Military Bases in Countries of Central and Eastern Europe



Source: Institute for Ecology of Industrial Areas, 1996

Figure 21: State of Underground Water and Soil Pollution Left From Former Soviet Military Bases in Countries of Central and Eastern Europe

contain information about contamination. Although an American military contingent led by Lt Colonel Jay Carson, which investigated these bases in the early 1990s, found the contamination from these bases to be fairly isolated in nature, it still remains a serious threat to the environment and will be very difficult and costly to remove.

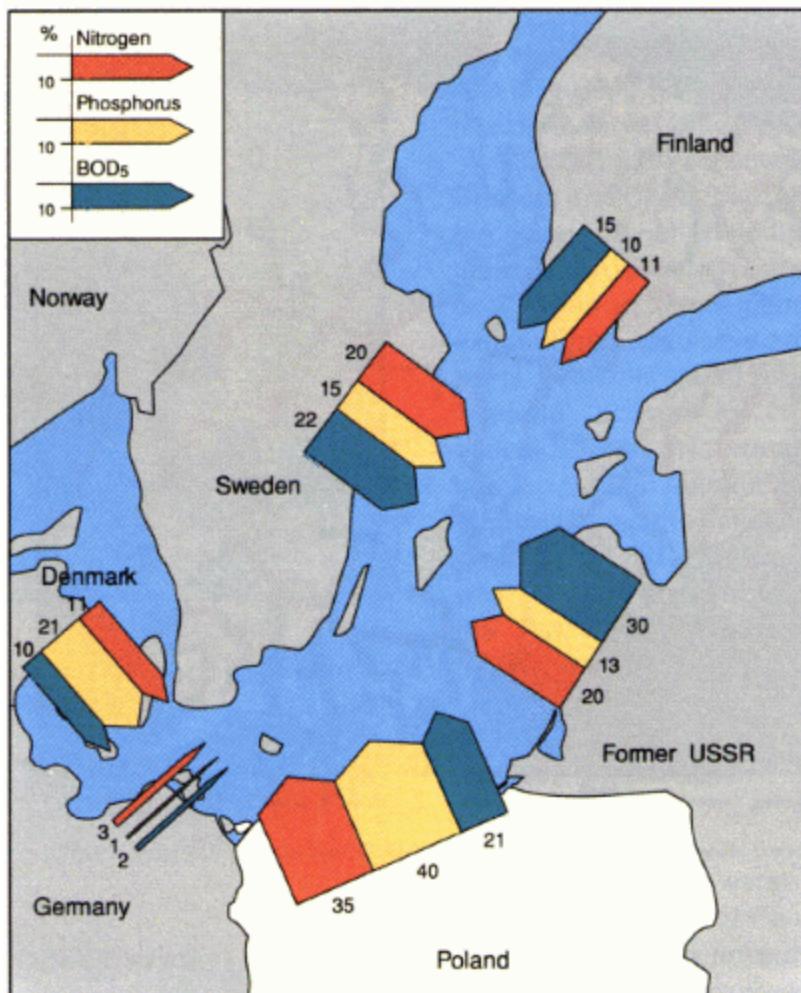
The third major source of water pollution is agricultural practices. A large percentage of the fertilizers, pesticides and herbicides applied to fields is washed away when it rains into nearby streams and rivers. Some of the chemicals also leach through the soil and reach the groundwater. Many of Poland's lakes experience eutrophication (i.e. excessive algae bloom due to high levels of nitrogen and phosphorous in the water) which greatly reduces the oxygen content of the water and consequently disturbs the surrounding ecosystems. The large scale animal husbandry practiced on huge farms in Poland also threatens the country's water resources. Most of the organic animal waste is spread on fields in an uncontrolled manner resulting in levels of nitrates that typically exceed 10mg per liter in drinking water drawn from shallow wells (NEAP, 1995).

3.2.3 Pollution of the Baltic Sea

The preservation and protection of the Baltic Sea from contamination has become one of the most important international environmental issues in the Baltic region. The small shallow sea (greatest depth is 870 feet) has only limited exchange of water with the Atlantic Ocean through a narrow channel between Denmark and Sweden. Since 99.5% of the territory of Poland is within the Baltic Sea catchment area, the Sea eventually receives most of the municipal sewage, industrial effluents, and agricultural products that are dumped into Poland's rivers. In

1989, of the total sewage load fed into the Baltic Sea by surrounding European Countries, Poland contributed 40% of the phosphorous, 35% of the nitrogen, and 21% of the organic matter. Figure 22 illustrates sources of pollution into the Baltic Sea. This contamination causes eutrophication of the sea which leads to an oxygen deficit and the release of hydrogen sulfide in the deeper layers of the water. As a result, 'bottom deserts' or dead zones occur in the waters off of Bornholm and Gdansk which negatively influence the fish living near the sea floor. Due to these zones, in Kattegat the geographical range of commercial fishing has shifted to the north, and the traditional spawning grounds for cod were destroyed (Andrzejewski, 1993). The pollution also threatens many of the fragile coastal habitats and creatures such as the Baltic Gray Seal and the Baltic Herring (Stoddard, 1995). A significant portion of the overall pollution load carried to the Baltic Sea by the Vistula and Odra rivers originates outside Poland. The contribution of heavy metals from the Czech and Slovak Republics and the Ukraine is especially large. This pollution comes mainly from the Ostrava-Karvina region and the Novy Wolyn Industrial Region of the Ukraine.

Fourteen countries with Baltic coastlines or interests including Poland have formed the Baltic Sea Joint Comprehensive Environmental Action Program, which has targeted 124 pollution trouble spots around the region which are in demand of urgent attention. Work has started on seven projects which the group has agreed on as part of a \$23 billion plan which will last until the year 2012. The world bank will foot 60% of the bill for the initial seven projects which will be conducted in Russia, Estonia, Latvia, Lithuania, and Poland (Stoddard, 1995).



Source: Nowicki, Environment in Poland, 1993

Figure 22: Sources of Pollution Into the Baltic Sea

3.2.4 Future Initiatives to Improve Water Quality

As part of the “*National Environmental Policy Implementation Program Through the Year 2000*,” Poland plans to implement a working plan which focuses on water protection based on the goals of reducing effluents of untreated sewage by 50% by the year 2000 and increasing the volume of wastewater treated biologically and chemically by 30%. This should reduce the Baltic pollution load, both direct and by rivers, by 20% of BOD₅ and 8% of phosphorous. To achieve these goals, investment efforts through the year 2000 will be focused on the following:

- construction of highly efficient wastewater treatment plants based on modern Western European technologies which are equipped with energy saving equipment in Koszalin, Szczecin, Nowy, Targ, Pruszkow, Swinoujscie, Cieszyn, Prudnik, Warsaw, and Lodz;
- modernization of existing plants and installation of more efficient technologies;
- reduction of discharges of sewage into the rivers of the Pomerania Region or directly to the Baltic by commissioning of treatment plants in Swinoujscie, Koszalin, and Tczew;
- limiting of negative impact of hot spots in the Vistula and Oder River basins in accordance with the Helsinki Convention on Protection of the Marine Environment in the Baltic Sea - six new treatment plants in the Vistula drainage basin will be constructed and three in the Oder drainage basin;
- protection of drinking water supplies by building water treatment plants in Sieradz and Pultusk;
- elimination of local pollution sources that pose a health risk to citizens through drinking water by constructing water treatment plants in Sosnowiec, Chorzow, Krosno, Leszno, Radomsko, Bialystok, Kamienna, Gora, Bielsko-Biala, Nowy Targ, Cieszyn, Prudnik, Wroclaw, Zielona Gora, Poznan, and Pruszkow;
- improvement of sanitation conditions in local areas, especially in villages through development of small natural systems for wastewater treatment installed on individual farms or groups of farms through subsidies;
- elimination of impact of coal industry on Vistula drainage basin water by building a desalination plant in Oswiecim for the Piast, Czeczot, and Ziemowit coal mines.

Activities connected with the implementation of a new legal act entitled the “*Water Law*” include the following:

- special water permits for sewage discharges to water and soil will be obligatory, and the permits for special use of water that were given before 1 January 1975 will no longer be valid;
- legal conditions for wastewater discharges to water and soil will be amended in accordance with EU standards and the Baltic Sea Convention;
- conditions of sewage discharges to municipal sewage systems will be set;
- requirements on using water from catchment areas or parts of them which will constitute the basis for formulation of individual water permits will be set;
- progressive fees for the use of water and water facilities will be introduced according to the intensity of water use or non-compliance with legal requirements of water permits;
- elimination of administrative clause which exempts firms from non-compliance fines if the conditions set in the water permit impairs their economic performance;
- the obligation that wastewater coming from polluted areas (especially urban, industrial, municipal, storage, transport route, and parking areas) should be discharged to sewage systems and treated.

Additionally, it is anticipated that the Polish Committee for Standardization will set standards on the content of phosphate compounds in washing powders, and that the Polish Center for Research and Certification will establish a system for certifying products that meet the requirements of water protection.

Specific non-investment activities will be undertaken in order to improve sanitation conditions in villages. These activities will be aimed at providing villages which have water supply systems with sewage systems and wastewater treatment plants. Specific measures include setting conditions on wastewater discharge to water or soil when landowners use surface

or ground water for their households and farms, and engaging local governments in monitoring compliance with the water protection conditions within the framework of ordinary water use.

3.3 SOILS

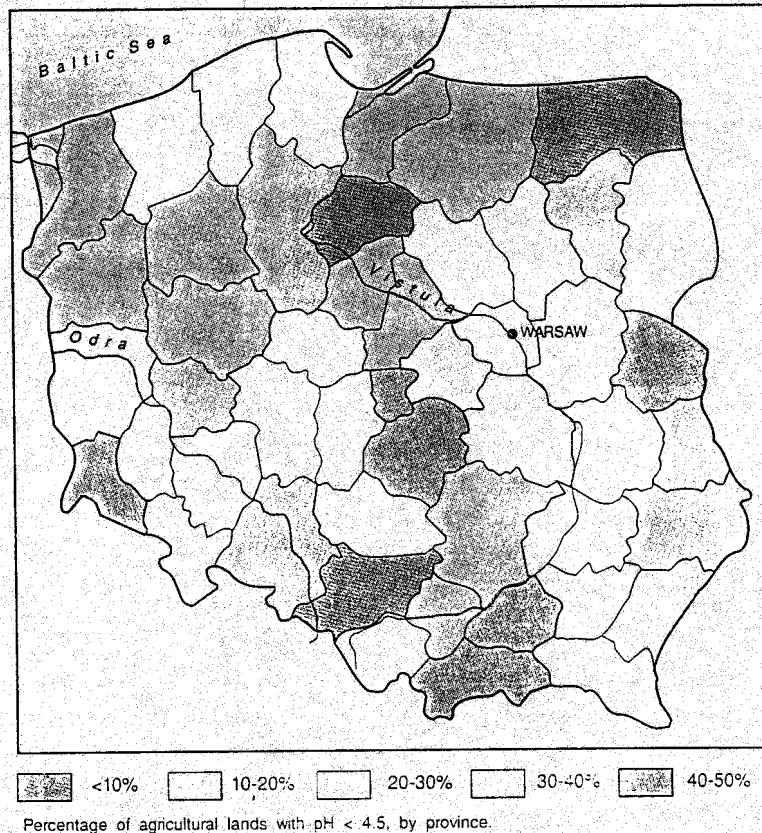
The average quality of Polish soil is fairly bw. Only about 23% of ploughland soils can be considered good or very good (classes I-III), while the poorest soils (classes V-VI) cover over 30% of Polish ploughland (Witek, 1993). The soil cover of Poland is characterized by large variability. In some regions it is even mosaic-like, with areas of very good and very poor soils next to each other over a one hectare area.

Poland's soil suffers from widespread erosion which affects 8-10% of the total acreage of ploughland and amounts to a loss of about 18 millimeters per cubic meter per year (Mazurski, 1989). Significant changes in the natural environment, including changes in the soil cover are a result of water system disturbance by people. The utilization of land for agriculture depends on the drainage of portions of the country's 2,600,000 hectares of peat bogs. As a result of the drainage, the peat bogs turn into marshes and mineralize. This is followed by a loss of soil mass, which causes the soils to become more and more shallow until they are completely gone. In Poland the peat bog deposit areas are lowered at the average rate of one centimeter per year.

Large changes of hydrological conditions, including excess or lack of water, are caused by the mining industry and the utilization of deep waters for industrial and municipal purposes. This worsens the water conditions of the soils and often leads to their degradation. An example of this is the region around the strip-mine "Belchatow".

Poland contains large areas of soil which are naturally acidic due to the natural soil creation process. Over the last few decades the process of acidification of the soils has intensified. In the farmlands it was caused to a certain extent by heavy dosages of mineral fertilizer, some of which was acid salts. The largest share of contamination is due to gaseous pollution of the air by sulfur dioxide and nitrogen oxides. This contamination reaches the plant cover and soil in the form of acid rain and dry deposits. The latest studies show that 60% of farmlands are acidic and have experienced chemical degradation (Witek, 1993). To combat the soil acidity, it is common practice in Poland to apply heavy doses of lime fertilizers to the farmland. Soil acidity in Poland in 1990 is illustrated in Figure 23.

In some regions of the country, particularly in the south and southwest, areas of soil have been contaminated by pollutant carrying dust from industrial emissions. Unusually high amounts of cadmium, lead, zinc, copper, mercury, nickel, chromium, boron, and other elements have been detected in various locations depending on the type of industry in the area. In 1988 the Polish Government permanently evacuated five villages in Silesia due to extensive soil contamination by heavy metals (Haggin, 1992, Ember, 1990). Only 0.5% of Polish farmland is contaminated and degraded to the point that it can no longer be farmed (excluding the so-called safety zones around the factories). The largest area of highly contaminated soils is Katowice, especially in the Upper-Silesian Industrial District.



Source: Nowicki, Environment in Poland, 1993

Figure 23: Soil Acidity in Poland in 1990

3.3.1 Initiatives to Reduce Soil Contamination

Poland is actively pursuing several initiatives toward ecologically sound agriculture in an effort to reduce or prevent soil contamination and degradation. *‘The National Environmental Policy Implementation Program Through the Year 2000’* calls for the use of proper agricultural methods such as ecological farming, liming, and use of natural fertilizers, limiting the influence of soil contamination on the condition of plants, and stimulating changes in land-use patterns in areas that are chemically polluted. Areas of special concern are the Katowice and Legnica provinces where contamination of the soil is causing the production of food with unsafe levels of toxic chemicals. Poland is currently pursuing the following activities in an effort to change management practices on chemically contaminated agricultural lands:

- assessment of permissible levels of soil and air contamination so that determinations can be made as to which lands should be excluded from food production;
- development of a program for discontinuing food production on the contaminated portions of Upper Silesia;
- preparation of a program for managing land contaminated by pollution by the metallurgy industry by growing plants such as linen, hemp, grain, potatoes, and rape-seed which can be used by the cellulose, textile and chemical industries in the Legnica-Glogow Copper Basin;
- identification of areas suitable for production plants which may be directly consumed, and also the most polluted areas within which food production should be limited or abandoned immediately;
- preparation of detailed research on soil and plant pollution and a map of critical loads on the environment within contaminated areas with the aim of properly locating food production;
- leading efforts within selected local authorities of the Katowice and Legnica provinces to promote changes of arable land-use co-operating with farmers to establish ways for further use of these areas, including necessary assistance in the implementation of these actions.
- liming of the soils made most acidic by industrial pollution and other factors, covering about 4 million hectares;

- completing research on the use of available, inexpensive, domestic materials for reclamation of soil contaminated by heavy metals;
- increase in the use of organic manure and compost fertilizers on farms;
- counteracting soil erosion by changing land uses (land consolidation, planting tree shelter belts, fertilizing to increase humus content);
- conducting annual tests on pesticides with regard to health and environmental protection requirements.

3.4 WASTE MANAGEMENT

3.4.1 Municipal Waste

In Poland the amount of municipal waste generation rose continuously until 1989. A decline in waste generated has been observed over the past five years. This decline is associated with lower production from small manufacturing enterprises as opposed to a change in the people's disposal habits. The per capita municipal waste generation per year is about 1.2 cubic meters (Nowicki, 1993) which is very low compared to the United States which generates an average of 10 cubic meters per person (Tchobanoglous, 1993). The volumes of waste vary according to the type of housing and type of heating system used. Areas of the country with multi-story buildings with district heating arrangements generate the most food waste and the least ash resulting in waste with high moisture and high organic content which is suitable for composting. Areas with single family houses heated by home stoves produce the greatest amount of waste per capita due to the large amount of ash generated in the stoves. Due to the low moisture content of this waste, it is more suitable for incineration.

Overall, the municipal waste generated in Poland contains low levels of combustibles, and incineration requires additional fuels such as oil or natural gas. Its relatively high percentage of organic matter makes composting a better choice. Currently large composting operations exist in Warsaw and Katowice and a third one is being built in Zielona Gora.

Recycling efforts are evident in most of the larger cities in Poland. Specially marked containers can be found on city sidewalks for voluntary disposal of paper, glass, metals, and plastics as shown in the photograph in Figure 24. The recycling containers are maintained by the same companies who operate the trash collection and landfilling operations.

The organized collection and management of municipal waste is still unfavorable in Poland. Only 55% of the population was served by municipal sanitation systems at the end of 1994, compared to 90% in Western Europe. Sanitary landfills are in operation in the urban areas, but long term planning does not seem to be keeping up with the rising demand. The volume of waste in landfills has tripled since 1975, and for many towns the landfills are already beyond their official capacity. The most commonly utilized method of dealing with municipal waste has been the removal to local disposal sites. Collecting household waste in rural areas presents special problems in Poland. Only a few local government administrations have the capacity to collect and dispose of waste at properly prepared sites. It is common for farmers to 'dispose' of their waste on their own which has resulted in the existence of about 10,000 unauthorized refuse dumps in forests, roadside areas and inland waters.

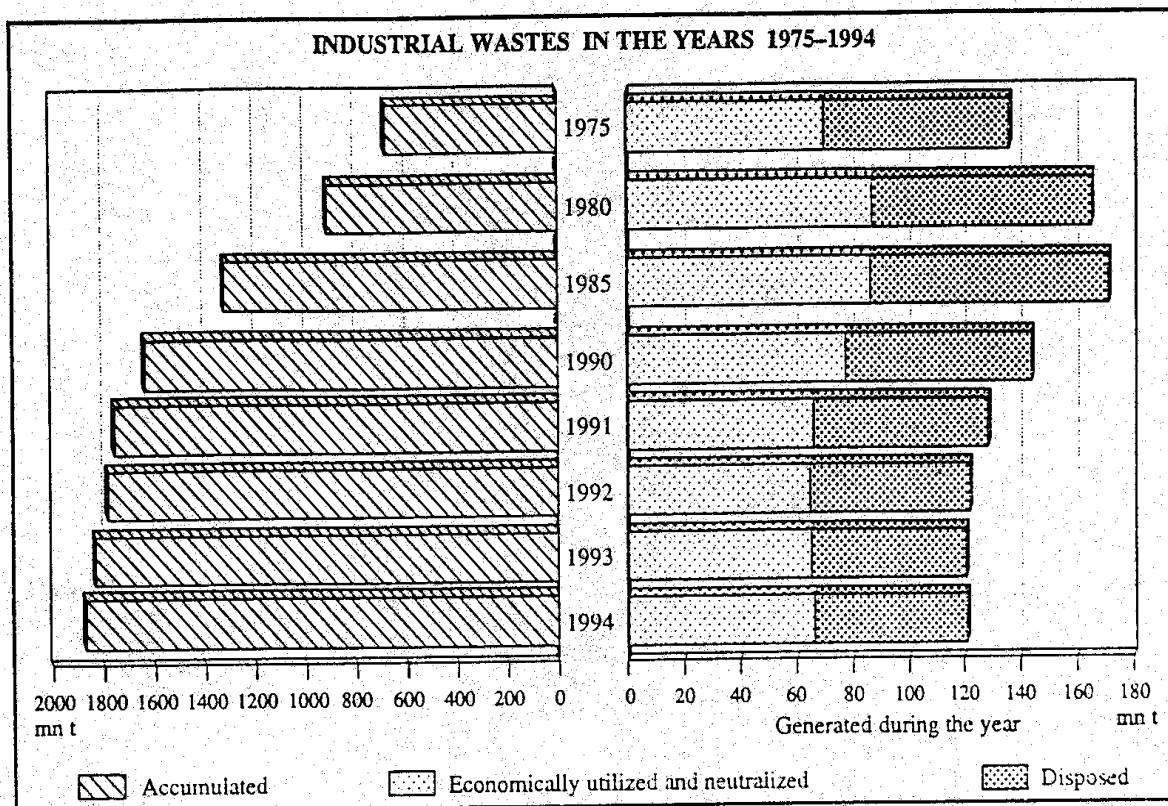


Figure 24: Recycling Containers in Krakow

3.4.2 Industrial Waste

The bulk of the industrial waste generated in Poland is associated with coal extraction and combustion: mine tailings and ash from power stations and heat plants. These substances combined made up 64% of all solid waste generated in Poland in 1990 (Nowicki, 1993). The next largest contributor is froth-flotation slurry and waste from coal washing processes, and from similar processes in sulfur, copper, zinc, and lead production. Another significant component is slag from iron, steel, and non-ferrous metal works. Almost half of the this industrial waste which has accumulated over the years in heaps, dumps, and holding ponds is located in the Katowice province. There are currently no incinerators for the disposal of industrial waste, and only 0.3% of the industrial waste is actively treated (OECD, 1995).

Unfortunately, there are currently no incentives for industries to minimize the amount of waste they generate. To the contrary, mechanization in the mining industry has greatly increased the amount of waste generated. The break which is seen in the statistical data for total waste disposal within the past eight years is due mainly to the decline in industrial output (i.e. mainly the drop in coal extraction), rather than to any increase in waste minimization practices. There has been an increase in the use of waste and refuse to fill unused mine galleries and to reclaim areas disturbed by mining. Industrial wastes between 1975-1994 are illustrated in Figure 25.



Source: Poland Quarterly Statistics, 1996

Figure 25: Industrial Wastes in the Years 1975-1994

3.4.3 Hazardous Waste

The Polish Ministry of Industry established the definition of hazardous waste as “waste containing substances that can cause adverse changes in living organisms as a result of direct or indirect effects, where changes can appear immediately or after a certain time” (Ministry of Industry, 1990). Based on this definition, Poland generates a considerable amount of hazardous waste consisting mainly of sediment and slurry from wet processes in the chemical, metallurgical, paint, tanning, petrochemical, and pharmaceutical industries.

On site dumps and holding ponds built without proper environmental controls or liners are common throughout the country. There is also a lack of incinerators or treatment facilities for hazardous waste. One of the first priorities of the PHARE program, a program through which the European Commission (EC) provides assistance to Central and Eastern European countries, is to build a large modern facility in Poland for the neutralization of hazardous waste using Western equipment.

Other major problems with Poland’s current hazardous waste management include: lack of precise information on the composition and toxic properties of waste from industrial plants; inappropriate usage and burning of hazardous waste; and disposal of hazardous waste without any attempts of recycling or reuse.

3.4.4 Importation of Hazardous Wastes into Poland

Although Poland banned the import of hazardous wastes in July 1989, the State Environmental Inspectorate found that 46,000 tons of toxic waste were transported into Poland for disposal in 1989 (PAR Enterprises, 1991). Germany was the key offender with 50% of the imports and Sweden, Austria, Switzerland, and Italy accounted for an additional 33%. The

wastes included solvents, paints, metals, electronic scrap, sewage sludge, and incinerator residues. Upon arrival in Poland the wastes were usually mislabeled and stored in inadequate facilities.

Excellent progress has been made by the Polish Government in controlling the import and the export of hazardous waste by using their authorities to tighten controls and by implementing better enforcement and coordination programs through the Customs Office and the Ministry of Environmental Protection. The new efforts have resulted in a virtual shut-down of Poland's borders to all types of waste. Additionally, bilateral agreements were signed with adjacent countries during the *1992 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* which provides for notification and regulation of waste shipments across international borders.

3.4.5 Nuclear Waste

Data on the amounts of nuclear hazardous waste in Poland is very fragmentary. All the nuclear fuel products and weapons owned by the former Soviet Union were removed by the Soviet troops when they departed after World War II. Public opposition to the development of nuclear power in Poland has eliminated the threat of a large scale nuclear waste problem. There are two small research reactors, only one of which is currently operating, which have produced a small amount of nuclear waste in the form of spent fuel rods which are stored on site. Additionally, small amounts of low and medium level nuclear wastes are produced by medical facilities, scientific laboratories, and other research institutes (Mark Pella, Science Section, U.S. Embassy, Warsaw).

3.4.6 Future Waste Management Investments

As part of the “*National Environmental Policy Implementation Program Through the Year 2000*,” Poland plans to attain the general goals of limiting the amount of waste deposited in landfills and reusing industrial and hazardous waste. Anticipated investment activities include the following:

- construction of two incineration plants (one in Warsaw and one regional) with a capacity of 600 tons per day;
- construction of 10 composting facilities with a capacity of 100 tons per day each;
- establishment of 10 large regional landfills;
- establishment of a large number of local landfills for easy access for townships;
- construction of three regional facilities for the treatment of industrial hazardous waste with the capacity of 20 tons per day (in Bydgoszcz, Warsaw, and Silesia);
- organization of 20 regional systems for treatment and disposal of hospital waste;
- construction of 10 facilities for disposing of mining waste;
- construction of facilities to mix saline water with fly ash from power plants to neutralize mine leachate;
- construction of facilities to produce gypsum from substances obtained from flue gas desulphurization;
- development of broad educational activities regarding management of waste and technical and organizational issues;
- promotion of new Polish technologies and subsidization of research.

Specific initiatives already undertaken to reduce the impact of solid waste in the city of Krakow include:

- the reclamation of 55 hectares of excavations at the Czatkowice Limestone Mine;
- the reclamation of 28 hectares of sedimentation ponds at Krakow's Sodium Works;
- construction of a slag recovery plant at the T. Sendzimir Steelworks with the capacity of 750,000 tonnes per year (Kobiet, 1995).

4.0 ENVIRONMENTAL MONITORING

Environmental monitoring in Poland has been carried out since the 1930's. It began with forestry workers trying to connect forest productivity with observed changes in the environmental quality. In the years that followed, numerous attempts were made to investigate the quality of Poland's environment, but it was not until 1990, when the Polish Prime Minister directed the Minister of Environmental Protection, Natural Resources and Forestry to set up a team to develop the state environmental monitoring program, that a reliable and useful system emerged. The legal base for the functioning of the state environmental monitoring system was laid down in 1991, after the Parliament of Poland passed the State Inspectorate of Environmental Protection Act. In 1992, the State Environmental Monitoring System, coordinated by the Chief Inspector of Environmental Protection and implemented by the State Inspectorate for Environmental Protection in cooperation with the State Sanitary Inspectorate, was established in Poland.

The tasks of the State Environmental Monitoring System include:

- providing information on the current state of specific environmental components and pollutant loads discharged to the environment;
- analysis of processes and phenomena occurring in the natural environment and determination of the dynamics of its anthropogenic transformations;
- providing information for environmental modeling and forecasting on the local, regional, and national levels.

The State Environmental Monitoring System consists of six subsystems:

- air monitoring, including noise and non-ionizing radiation;
- monitoring of surface waters including the Baltic Sea;
- monitoring of ground water;
- land surface monitoring including soil and waste;
- monitoring of nuclear contaminants.

In each of the subsystems there are national, regional and local station networks and measurement points in operation, which are being expanded and modernized as needed. The monitoring system closely cooperates with the health monitoring system coordinated by the Chief Sanitary Inspector and the food product and crop monitoring system coordinated by the Ministry of Agriculture and Food Economy. Along with reciprocal exchange of information, this cooperation also includes joint taking of some measurements regarding air monitoring and soil monitoring.

The State Inspectorate for Environmental Protection is obligated by law to disseminate the information it collects on the environment. The environmental data dissemination system currently in operation includes:

- (a) reports on the state of the environment in Poland, issued every three years by Headquarters of the State Inspectorate of Environmental Protection;
- (b) issued annually:
 - reports on the state of specific environmental components by the Chief Inspectorate of Environmental Protection;
 - reports on the state of the environment in particular provinces by provincial inspectorates for environmental protection in cooperation with environmental protection departments of provincial offices;
 - reports of the *Environmental Protection* series by the Central Statistical Office;
 - reports of the *Forestry* series by the Central Statistical Office;
 - reports with summaries of sectoral statistics by the Ministry of Environmental Protection, Natural Resources and Forestry;
- (c) issued monthly:
 - bulletins on air pollution,
 - bulletins on surface water pollution,
 - bulletins on air pollution at stations in Krakow, Katowice, the Sudety Mts. Area (so-called Black Triangle) and Warsaw,
- (d) weekly bulletins on atmospheric radioactive contamination,
- (e) daily bulletins on air pollution in urbanized industrial areas,

(f) summary reports of the *Environmental Monitoring Library* series, which present studies done within the framework of monitoring by various scientific and research units and other organizational units (about 70 publications in this series have been issued since 1992).

The biggest challenges the State Environmental Monitoring System currently faces are: the expansion of existing computer databases on emissions sources; the unification of computer hardware and software used in monitoring; the implementation of a quality assurance program to include the certification of laboratories and calibration of the measurement instruments; and the expansion of the monitoring system to include waste and municipal wastewater and such air pollutants as heavy metals, aromatic hydrocarbons, and carbon dioxide. Poland would also like to implement a geographical information system as part of the State Environmental Monitoring System.

4.1 AIR MONITORING PROGRAM

“The aim of the air monitoring program is to provide data creating the basis for undertaking the actions for reduction of emissions of pollutants into the atmosphere, assessment of these action’s efficiency, and assessment of the hazards for the population health, natural ecosystems, and technical objects from the pollutants present in the air.” (Wakewski, 1992). The current standards for air quality in Poland were established by the Minister of Environmental Protection, Natural Resources and Forestry in 1990 as tabulated in Table 6.

Pollutant	<i>Averaging Time</i>		
	30 min standard	24 hour standard	1 year standard
SO ₂	0.6 mg/m ³	0.2 mg/m ³	0.032 mg/m ³
NO _x (as NO ₂)	0.5 mg/m ³	0.15 mg/m ³	0.050 mg/m ³
CO	5.0 mg/m ³	1.0 mg/m ³	0.12 mg/m ³
O ₃	0.1 mg/m ³	0.03 mg/m ³	
Particulates		0.12 mg/m ³	

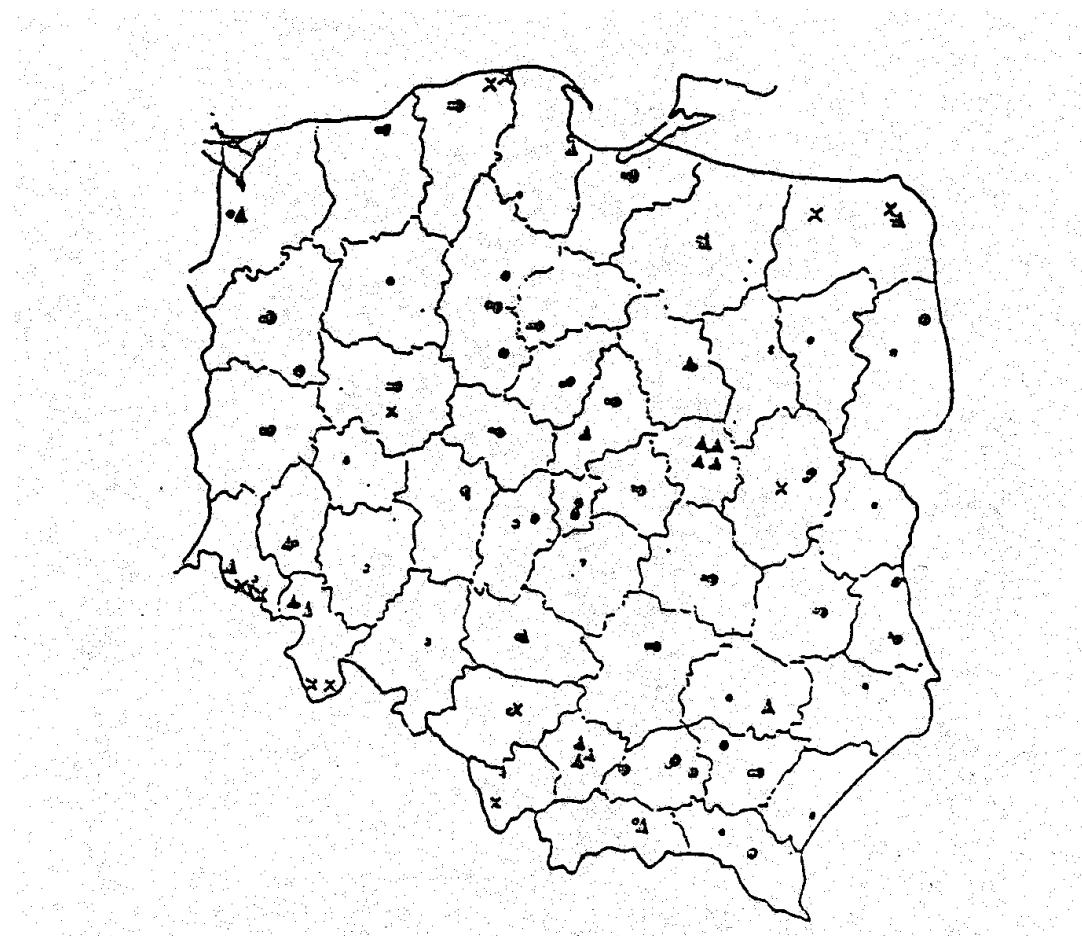
Source: Air Monitoring Station, EPA - Institute of Environmental Protection, Warsaw, Poland, June 1990.

Table 6: Current Standards for Air Quality

The national air monitoring network consists of 49 basic stations and over 8000 supervising stations of the State Sanitary Inspectorate. The basic stations are located throughout Poland forming a network which covers most of the country (see Figure 26). The task of the basic stations is to record air pollution data in Poland's lower atmosphere to evaluate the trends in changes of air quality (see Figure 27). At these stations measurements of the main air pollutants; SO₂, NO_x, and particulates are carried out 24 hours a day. The results of these measures are continuously displayed electronically as shown in Figure 28. The general supervising stations of the Sanitary Inspectorate are located in the densely populated areas. They measure SO₂, NO_x, and particulates as well as concentrations of pollutants which are characteristic for the given region and which are harmful to the populations health or are a special hazard to the region.

The State Environmental Monitoring System also includes regional air monitoring networks.

The regional air monitoring networks fulfill closely defined tasks related to providing



Source: Walewski, State Environmental Monitoring Program, 1992

Figure 26: Locations of the Basic Air Monitoring Network Stations



Figure 27: An Air Monitoring Station in Krakow



Figure 28: Readings from Air Monitoring Station

information about concentrations of the individual pollutants in the region. The regional networks also serve as alarm systems by providing data on the existing or expected concentrations of health hazardous substances in order to notify inhabitants to take actions to reduce their exposure. The alarm networks are still being developed in some areas and they are located in the densely populated regions with highly polluted air. An alarm network is already in operation in Krakow. It was constructed with aid from the U.S. Environmental Protection Agency.

There is actually another program in Poland for the measurement of air pollution in addition to the State Environmental Monitoring System. The other program belongs to the industrial plants and other specific sources of airborne emissions. According to the 1990 Regulation by the Minister for Environmental Protection, emissions measurements are the responsibility of the organizational unit discharging the pollutants into the air. Organizations which discharge more than 1200 kg of SO₂ or 800 kg of particulates through one point source in one hour are obligated to run a continuous monitor for the discharge quantities of these substances. The organizational units which have the potential to discharge more than 100 kg of SO₂ or 100 kg of particulates per hour are obligated to measure the quantities of these substances twice a year on dates agreed to with the local authority of the provincial level (Walewski, 1992). All the emissions measuring units must be accredited by the Central Product Quality Office and certified by the State Inspectorate of Environmental Protection. The data is collected in the computer databases of the Provincial Inspectorates of Environmental Protection and is used for verification of the decisions about permissible emissions, for verification or adoption of emission indices, to make future administrative decisions, and for calculating pollutant fees and penalties for exceeding the standards. The industries are encouraged to take advantage of the data for

optimizing their technologies and for the assessment of the efficiency of their air pollution control devices. The data is also valuable when calculations are done concerning the transboundary export and import of pollutants to and from Poland.

4.2 WATER MONITORING PROGRAM

Measurements and information on water quality are produced by specialized services such as the State Inspectorate for Environmental Protection, the Institute of Meteorology and Water Management, and the State Geological Institute. The Geological Institute's stationary groundwater monitoring network has approximately 600 stations, including 40 with multiple bore holes. Contaminant levels and flows of major rivers such as the Vistula and Oder are continuously monitored by a national network of 640 measurement points within the rivers and 56 measurement points along international borders. Thirty-three of Poland's lakes are continuously monitored, 1050 are part of the national monitoring network and are regularly assessed, and efforts are underway to establish additional 1150 measurement wells for groundwater quality and quantity (OECD, 1995).

5.0 ENVIRONMENTAL INFRASTRUCTURE

5.1 CZAJKA WASTE WATER TREATMENT PLANT

Czajka waste water treatment plant was put into service in 1989 after twenty years of design and construction. The plant was designed for a capacity of 400,000 m³ of sewage per twenty four hours, and at present receives an average daily flow of 240,000 m³. Because of the long construction period, the plant was already outdated at the starting point. Numerous technological, hydraulic and operating deficiencies were also discovered. These factors necessitated a complete modernization of the plant which is being done successively with current plant operations.

The sewage from the part of Warsaw situated on the east bank of the Vistula River flows to the plant through an intermediate pumping station called Zeran. This part of the city has a combined sewage system, resulting in an increase of waste water pumped to the plant of around thirty percent during periods of rain.

About forty percent of the total amount of waste water entering the plant is of industrial origin, mainly from car factories, and pharmaceutical, meat processing, and chemical industries in the area. The remaining sixty percent is of municipal origin.

The plant was designed in a traditional fashion as illustrated in Figure 29. Primary treatment consists of bar screens, grit chambers, and sedimentation tanks with traveling bridge scappers. Secondary treatment uses biological aeration tanks and settling basins. The effluent is then discharged into the Vistula River. Although the plant is undergoing modernization to meet discharge standards, it continues to have difficulty removing nitrogen and phosphorous compounds.

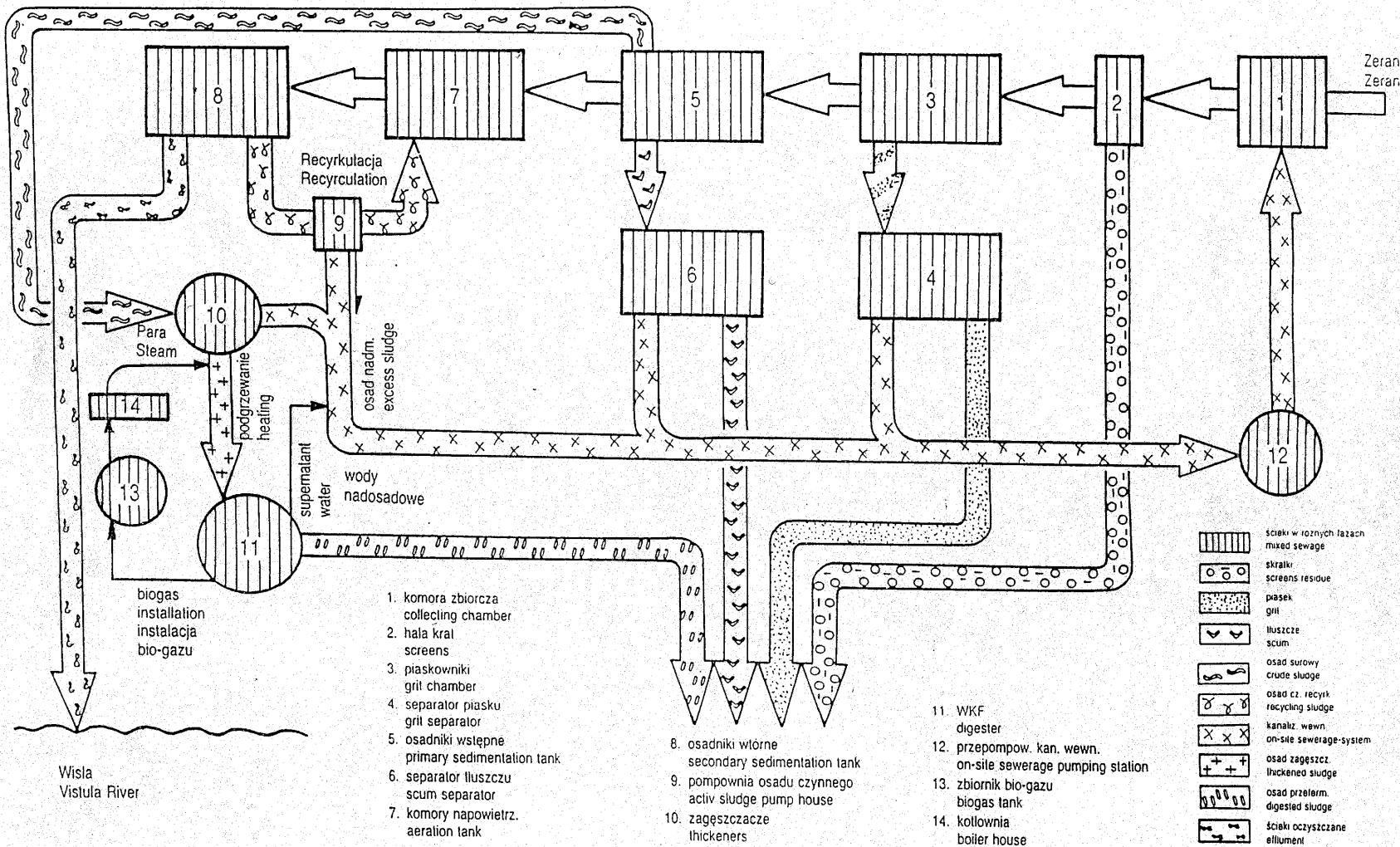


Figure 29: Czajka Waste Water Treatment Plant

Sludge from the plant is dewatered in a centrifuge then treated in a heated digestion plant after which it is landfilled. The biogas produced from the sludge digestion is used to operate the boilers which provide the heat for the digestion. The gas is also used to provide heat for the plant buildings.

The plant employees 206 workers. The large number in comparison to United States plants is mostly due to the fact that the plant controls are not automated, but rather manually operated.

The Czajka Waste Water Treatment Plant is by far the most modern treatment facility in the country. The waste water from the portion of the city on the west side of the Vistula River undergoes primary treatment only at the stage before it is discharged.

5.2 DAEWOO-FSO MOTOR COMPANY

The FSO Motor Company was purchased by Daewoo, a Korean auto maker, in March of 1996. At the time, FSO was the manufacturer of one of the most popular cars in Poland, the Polonez. A visit was made to the Zeran Plant in Warsaw, which employs nearly 10,000 people, to discuss environmental concerns. The plant first opened its doors in 1948.

Air pollution is a major concern for Daewoo-FSO. Large groups of people live within the factory boundaries in housing provided by the company. Ambient emissions of hydrocarbons such as toluene and xylene are monitored regularly to ensure the safety of the workers and their families. Specific examples of Daewoo-FSO's effort to reduce air emissions are the construction of a new paint chamber with better emissions control and the change to water soluble paints for the undercoats.

Daewoo-FSO decided to comply with the standards set for each smoke stack by the Regional Center for Environmental Protection rather than continue to pay fines for exceedences. In 1995, FSO was fined 5,000 zloty (\$1 US = 2.65 zloty) for exceeding toluene emissions standards on three of their smokestacks. They are inspected periodically by the State Inspectorate for Protection of the Environment. The company was also paying 500,000 zloty per year in fees for the privilege of emitting pollution into the air.

Daewoo-FSO has also paid fines for exceeding waste water standards. There are two waste water purification units at the plant; one for waste water from the paint shop and one that handles the rest of the production waste water. Chemical emulsion purification units remove some of the contaminants before the water is discharged into the municipal system. This discharge is regulated by standards and agreements with the main water station in Warsaw as to what FSO can discharge and how much clean water they can draw from the system.

There are currently no regulations for noise pollution outside of the plant. Inside the plant, the Safety and Hygiene of Work Office controls noise standards for workers and takes measurements. This office also measures and takes samples of internal dust pollution. The samples are sent to the Center for Sanitation, Hygiene, and Epidemiology for testing and recording.

In 1992, the Daewoo-FSO factory volunteered to submit itself to higher levels of control by signing a declaration sponsored by the Ministry of Environmental Protection and the Ministry of Trade. In this declaration, Daewoo-FSO agreed to look into reducing the amount of waste from the start of the manufacturing process as part of a waste minimization program. The country of Norway has paid for the education of plant personnel on how to reduce the amount of pollution generated during automobile production. There are 30 such schools nationwide in

Poland. The classes consist of a one week introduction followed by eight stages over a period of 6 months. The course is very practical in nature and uses real projects to illustrate waste minimization techniques to the students. Thanks to this education, FSO's water consumption was reduced by 60% in relation to pre-1992. Waste water discharge was reduced by 40%, and trash generation was reduced by 30%.

From 10-12 June, 1996 DAEWOO-FSO sponsored an international conference in Warsaw in conjunction with the International Solid Waste Association (ISWA) called "WASTECARE '96" in order to present their achievements in industrial waste minimization, and with partners from Central and Eastern Europe, familiarize itself with the newest world solutions with respect to correct waste management policy and encourage investment in the protection of the natural environment.

5.3 MIEJSKIE PRZEDSIEBIORSTWO OCZYSZCZANIA (MPO)

Miejskie Przedsiębiorstwo Oczyszczania (MPO) is a waste disposal company located in Warsaw. MPO transports solid wastes to a landfill site, located in the outskirts of town, which they maintain and operate. The operation has a capacity of composting 580 tons/day, and is currently operating at a capacity of 540 tons/day (see Figure 30). State of the art equipment, including a biostabilizer, are used to compost garbage suitable for placement in the landfill site. The landfill in Warsaw will last for a projected 7 more years (i.e. at current rate it will be full by the year 2003). What may be a cause for alarm is that currently, no plans have been made as to the action(s) to take after the landfill is full.



Figure 30: Waste at Miejskie Przedsiębiorstwo Oczyszczania

5.4 INSTITUTE FOR ECOLOGY OF INDUSTRIAL AREAS (IETU)

In 1992, the Institute for Ecology of Industrial Areas (IETU), a former branch of the Institute of Environmental Protection, established itself as a separate, independent organization. IETU's mission is to: perform scientific research; prepare expert opinions and assessments; disseminate data and educate; collaborate nationally and internationally; and formulate a scientific basis for national environmental policy makers. The Institute's staff of 130 assists governmental decision makers to create environmental policies and performs scientific projects in conjunction with a variety of organizations including: the Ministry of Environmental Protection, Natural Resources and Forestry; the Polish State Committee for Scientific Research; foreign agencies; universities; private and public industries; and other Polish and foreign scientific establishments. IETU also offers presentations to the public, conferences, various training events, and a variety of publications.

IETU is actively pursuing cooperative projects with the US EPA including: methods of reducing population exposure to heavy metals from agricultural products by binding metals in soils; and a risk assessment study on the risks of PAHs on farmers.

IETU is working on several other cooperative projects such as: a UN ECE convention on long range transboundary air pollution, programs with the National Focal Center on "Integrated Monitoring of Air Pollution Effects on Ecosystems" and "Critical Loads of Airborne Acidifying Compounds", and a project with the Polish National Air Pollution Monitoring Network.

From 27-28 May, 1996 IETU held a Joint International Environmental Technology Exchange to provide attendees with the opportunity to network with other people who have a role in environmental cleanup technologies and issues. Participants included government and

local authorities, environmental service providers and consultants, soil and groundwater association representatives and members of environmental professional societies, managers of contaminated sites from Poland and other countries in the region, public officials, educators and researchers, journalists, and concerned citizens.

One project that IETU is particularly proud of is a result of the Institute's partnership with the U.S. Department of Energy. The DOE's Ames Laboratory at Iowa State University developed an innovative approach to site cleanups called Expedited Site Characterization (ESC). The system was developed to recognize the areas which are contaminated, to quickly identify pollutants using an inexpensive methodology, and to help choose clean-up technologies. Until now, ESC has been demonstrated only in the United States and has received very positive evaluations and acceptance from both commercial firms and the public. In a team effort with the Department of Energy, IETU, the Refinery Czechowice Corporation, Florida State University, Ames Laboratory, and Westinghouse Savannah River Company ESC will be applied for the first time in Europe in Poland. The ESC demonstration is part of a joint international project between the United States and Poland to demonstrate the methodologies and technologies associated with site characterization, risk assessment, and site remediation. This work will help transfer the methodology, know-how, and technologies of risk-based decision making processes to Poland and other countries in the region. These technologies are safer, faster, more effective, and less expensive than many of those currently in use. The demonstration will also encourage the introduction and use of US environmental technologies and services outside of the US.

The US Department of Energy chose Poland due to the large extent of the environmental damage that was done by the Soviets during their occupation of the country. Poland is being used as a focal point between the US and other Eastern European Countries because of the Pole's

good contact, relations, and language skills with these countries. The Czechowice Refinery was chosen as the site for the technology demonstration because the petroleum contamination which has been there for 100 years was originally started when the refinery was owned by an American Company.

The Czechowice Refinery project consists of the clean-up of three lagoons which hold concentrated petroleum sludge. Westinghouse has developed a new technology for soil remediation called the Biopile system. The Biopiles are constructed by alternating layers of polluted soil taken from the bottom of the lagoons and non-polluted soil. The clean soil contains natural bacteria which are kept alive by air and nutrients which are pumped through the pile. The bacteria degrade the petroleum compounds in the contaminated soil bringing the contamination down to acceptable levels. The Czechowice Biopile project will be showcased at a conference which IETU is holding in September, 1996.

IETU is also involved in developing another new approach to soil remediation called Phytoremediation. The Institute is hopeful that this project will be instrumental in cleaning up the large amount of agricultural land which is contaminated with heavy metals in the Upper Silesia Industrial Region. Recent measurements have shown that virtually all of the vegetables and pasture plants in the region contain levels of cadmium far above the safe limit value of 0.03 parts per million. Phytoremediation uses certain types of plants to stabilize, mineralize and remove the heavy metals in the soil through root uptake. The plants themselves are then removed and disposed of. Phytoremediation is an inexpensive natural way to remove the contamination, but it would mean that the farmers would have to relinquish parts of their fields for one or two growing seasons while the phytoremediation plants were harvested. IETU hopes that by educating the farmers and showing them the high levels of heavy metal which their crops

contain, the farmers will voluntarily choose to incorporate phytoremediation into their growing process. Dr. Aleksandra Nowosielska, who is in charge of the project, reports that the younger farmers seem to understand the scope of the contamination problem and are receptive to phytoremediation, but the older farmers remain skeptical.

The condition of Poland's surface water was also discussed with IETU. Currently Poland relies heavily on chlorine to disinfect the drinking water. Dr. Boguslaw Buczak feels the water treatment plants over-chlorinate to the point where tri-halo methane (THM) byproducts are becoming a significant health risk. The main problem with the surface water is eutrophication due to high levels of nitrogen and phosphorous. Tertiary treatment is needed to fully combat this problem, but this level of treatment is out of reach financially for most Polish communities.

5.5 BANK OCHRONY SRODOWISKA S.A.

Bank Ochrony Srodowiska S.A. is a financial institution which provides loans to individuals committed to the development of environmental projects at low finance rates. It ranks among the top twenty banks in Poland with respect to both the level of share capital and the size of operations. There are currently 24 branches of the Bank located in all regions throughout Poland.

In 1994, the Bank began extending low interest loans to large environmental projects of significant importance to the national economy of Poland. Generally, lending rates of up to 25% below the prime rate are offered to clients of the bank. Preferential terms were achieved using funds provided by the National Fund for Environmental Protection and Water Management to cover this 25% difference. This fund is comprised of money collected from violators of environmental compliance in Poland.

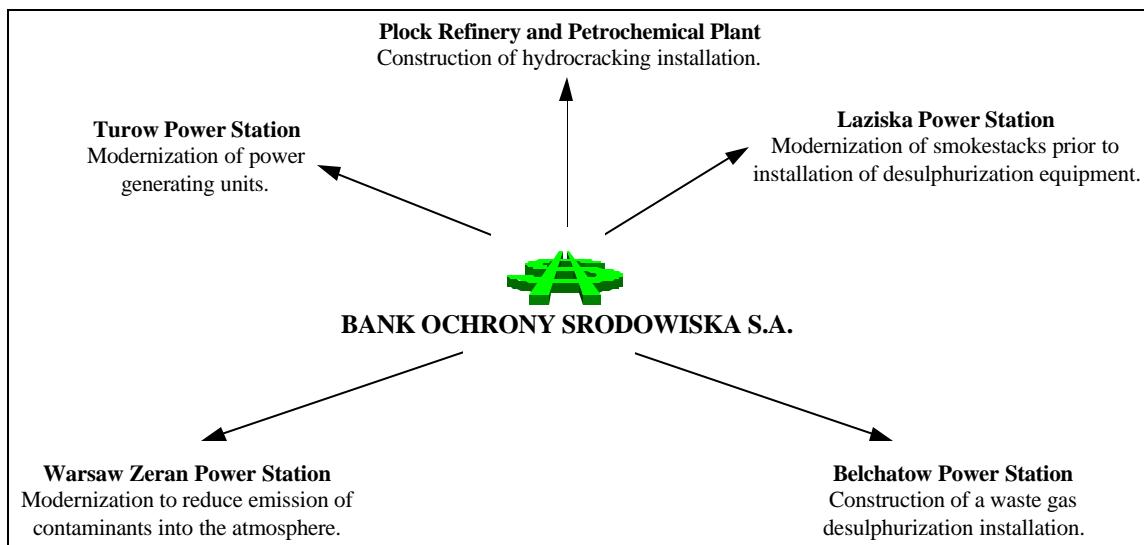


Figure 31: Environmental Projects Financed by Bank Ochrony Srodowiska S.A. in 1995

Loans extended by the Bank have resulted in the completion of over 800 environmental investment projects involving construction of sewage treatment plants, sanitary collectors, ash emission controlling installations, landfills and waste dumps, small hydro-electric power stations, etc. (see Figure 31). Currently, there are 247 projects under implementation using financing from the Bank Ochrony Srodowiska S.A. The Bank has helped contribute to the investment of \$1.5 Billion US in environmental projects in Poland during 1995-96.

6.0 INSTITUTIONAL CAPABILITIES

6.1 AGENCIES

6.1.1 Ministry of Environmental Protection, Natural Resources and Forestry

The Ministry of Environmental Protection, Natural Resources and Forestry, founded in 1985, is the highest level of environmental authority in Poland employing around 300 people. It is currently overseen by the Minister of Environment, Mr. Stanislaw Zelichowski. Figure 32 depicts the various offices within the organizational structure comprising the Ministry of Environmental Protection, Natural Resources and Forestry.

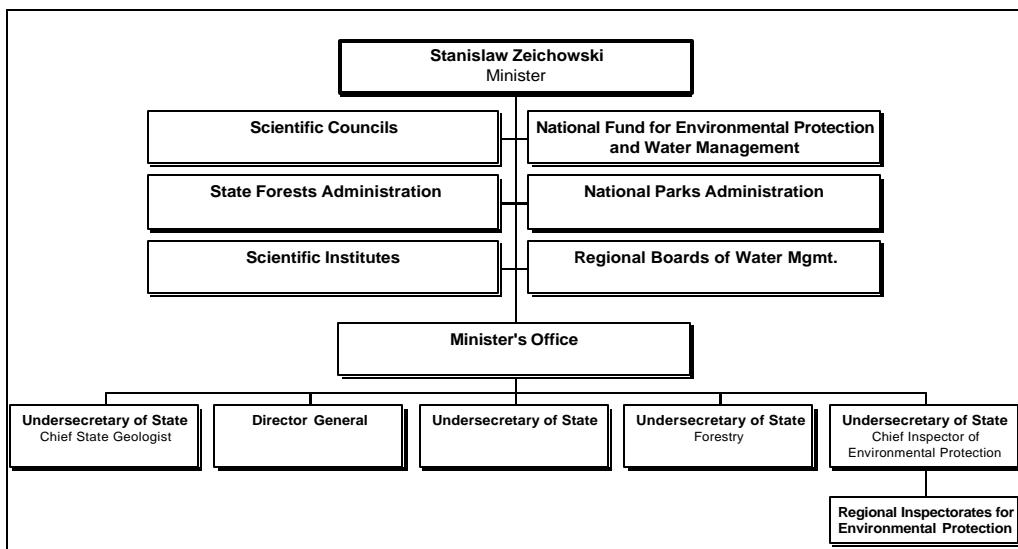


Figure 32: Organizational Structure of the Ministry of Environmental Protection

In early 1991, the State Environmental Protection Inspectorate was established to regulate polluting industries. Fines collected from environmental violators are placed in the National Fund for Environmental Protection and Water Resource Management. Almost thirty percent of the fund's revenue comes from fines on emissions of sulfur dioxide, nitrogen oxides, and saline

coal mining water. For example, the penalty for sulfur dioxide pollution is roughly \$72 US per ton of emission placing it amongst the highest in the world. In 1993, the fund became decentralized. Money from the fund, previously shared by the national fund and a respective regional fund, is now further shared with municipal funds. These accounted for a significant percentage of environmental expenditure in 1993 as illustrated in Figure 33.

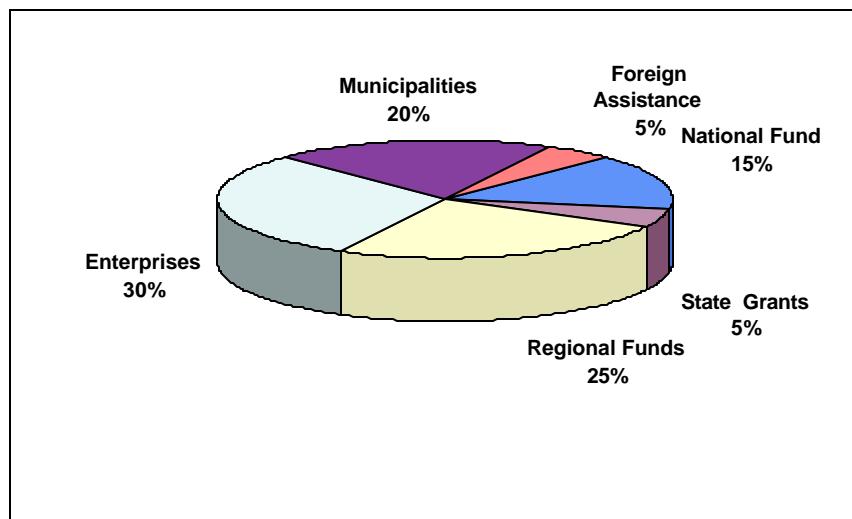


Figure 33: Estimated Breakdown of Environmental Financing in 1993

As part of their regulatory duties, the Ministry of Environmental Protection, Natural Resources and Forestry passed several laws including:

- Environmental Protection Act of 1980 (amended in 1989 and 1990);
- Protection of Arable and Forestry Grounds Act of 1982;
- State Environmental Protection Inspectorate Act of 1991;
- Nature Conservation Act of 1991.

Several other responsibilities of the Ministry of Environmental Protection, Natural Resources and Forestry include:

- environmental protection including; policy making, air pollution abatement, surface & subsurface water protection, nature conservation, landscape protection, noise & vibration abatement, waste management, nuclear waste protection, forest protection, mineral & arable land protection, wildlife protection, national park creation, environmental surveying, law improvement);
- supervision and inspection of the relation of investment on the environment;
- initiating and sponsoring of environmental protection activities;
- national research, development, education, and training;
- international cooperation (negotiating/signing agreements, exchanging data and experts, participation in conferences/meetings).

The Ministry of Environmental Protection, Natural Resources and Forestry also has several tasks related to Environmental Impact Assessment (EIA) including:

- reviewing and approving EIAs for projects deemed harmful to the environment and human health, jointly with the Chief Sanitary Inspector;
- defining the standard form and contents of the EIA, jointly with the Chief Sanitary Inspector maintaining a list of consultants and organizations authorized to undertake EIA.

6.1.2 Ministry of National Defense, Department of Social Relations

Discussions with Lt. Col Krzysztof Marszalik, Chief of Environmental Office, reveal that one of the most common problems encountered by the Polish military is that 90% of boiler rooms on installations are old and do not meet current standards. The military has the know how to restructure, however, there are severe financial restrictions as they receive no foreign funding. Currently, environmental cleanup of Polish bases has not been completed. The military has, however, built new water filters in response to concerns with water from drainage systems. There are currently 1000 water purifying systems on Polish military bases.

Solid waste from military bases are taken to local civilian dump sites for disposal because there is a major shortage of dump areas and trash burning facilities on military bases. Noise pollution is not a serious problem because of imposed flight limitations. Also, planes have been retrofitted with engine components which result in quieter noise levels. Similar to the US Air Force, acoustic maps are used in an attempt to limit noise pollution to the surrounding general public.

Another source of pollution adherent to the military is electromagnetic waste which is created by radar. The Polish military is currently trying to change the methods used to measure electromagnetic waste and have recently convened a Special Committee to investigate a method of measuring this waste using one “standard” type of device.

Firing ranges pose a threat to the environment due to reported cases of unexploded shells. The military is using a preventive approach of damage control by building fire stations strategically located on these ranges for quick response time. Also, there is a new policy of eliminating range training exercises during the months of July and August because of high fire

potential. An interesting observation is that the military has not currently developed any methods to assess damages resulting from military exercises.

The greatest environmental concern on military bases is pollution from Petroleum, Oil, Lubricant (POL) deposits in the ground. Pollution and contamination from POL has detrimental affects on the soil and ground water. Penetration of POL takes many years and could have begun taking place on military bases 20 to 30 years ago. The Polish military is currently in the process of testing all of their installations for POL contamination at a cost of between \$40 to \$50K US each. At several former Soviet bases, contamination is so bad that one foot layers of POL deposits, spanning 406 hectares, have been recorded in the soil covering ground water. The military is facing financial constraints in their effort to identify and cleanup polluted bases. The threat from this type of pollution became evident in the case of an underground water tank on a base near the town of Pila. The tank was nearly contaminated from POL deposits in the ground, however, quick identification, assessment, and cleanup of the situation prevented potential disaster.

The Polish military wants to take a proactive role, rather than a reactive role. Levels of water pollution on military bases have been identified. Of the existing 300 wastewater facilities, approximately 50% need to be renovated and another 100 more need to be built.

Inspections and measurements are usually done by the State Environmental Protection Inspectorate, however, some areas are inspected by the military. There are ten Military Councils for House and Construction including the Warsaw Garrison. Each council has its own laboratory to test drinking water and sanitary drainage. Wastewater is galvanized and oxidized before being transported to the city system. Similar to many US military installations, co-located bases pay for using electricity and sewer systems from the nearby city.

Currently, restructuring of the Polish Armed Forces is occurring affecting approximately 230,000 active soldiers. Within the environmental arena, the ultimate goal of the Ministry of National Defense is to allocate one person per battalion with the sole responsibility of monitoring environmental programs.

As mentioned previously, Former Soviet Union offers no support or compensation. One condition for their withdrawal was that Poland would never make any claims for environmental damages. Now both countries only have chance meetings at international conferences, meetings, etc.

6.2 REGULATIONS/LEGISLATION

6.2.1 Government Policy

Until recently, the Polish government has made little effort to combat pollution in the political realm. It has been suggested that a major reason why this is happening is because the Polish leaders are suffering the effects of the “fundamental paradox of Central Europe’s revolution: those who succeed in throwing out governments must now run them a job complicated by high public expectations and pent-up public distaste for strong central authority” (Hamilton, 1991). Many others feel that government policy has steered carefully away from measures that would sacrifice economic development.

Despite the fact that the government has been reluctant to take action, there has been upward progress made towards environmental protection. The first step occurred when Poland established its Ministry of Environmental Protection, Natural Resources and Forestry in 1985 and then the State Environmental Protection Inspectorate in 1991. Furthermore, the Polish

Ecological Club, founded in 1980, has had strong support to its “green” policies in Krakow which have led to renewed environmental sensitivity.

In the early 1990’s, several individuals suggested that the next step for environmental policy makers in Poland was to institute the “Pittsburgh Solution.” There is a feeling by some that it may not be financially sensible to retrofit the antiquated, highly polluting plants with new equipment to make them environmentally safe. One such sentiment was that these outdated plants would likely be shut down and pollution would decline, much as it did in Pittsburgh in the late 1970s and early 1980s with the closing of obsolete steel mills.

Poland’s environmental policies are generally good. The current *Environmental Policy* was approved and adopted by the Government and Parliament in 1991 and is based on the concept of “sustainable development.” In general terms, the main purpose of sustainable development is “to meet the needs of the present without compromising the ability of future generations to meet their own needs.” Although this Policy was passed into law, Poland still has a need to improve its monitoring of pollution and subsequent enforcement.

The Environmental Protection Act (EPA) of 1980 (amended in 1989 and 1990) established general principles of environmental policy and provides substantive legislation, including several section regarding public participation.

- Article 99 of the EPA authorizes certain social groups to act on behalf of the public in order to create conditions for public protest against activities harmful to the environment.
- Article 100 of the EPA provides for a specific right to know and a right to be heard exclusively to environmental associations participating in the decision process.

The Land Use Planning Act of 1984 contains a number of procedural rules concerning public participation. The public is to be informed in advance of intended plans through a public source of information such as announcements in the local media, etc. Institutions and non-

government agencies are to be informed by appropriate letters. The public must be informed of decisions and conclusions and be given the opportunity to comment at each stage in the preparatory process.

6.2.2 Political Activist Groups

Environmental activist and political groups in Poland currently do not have much influence in government decisions despite their numbers. Many of these groups formed in the late 1980s and early 1990s in response to government and corporate moves that would further harm the environment of Poland. The main driving force in the development of these groups occurred in 1980 when the Green Solidarity movement forced an aluminum plant in Krakow to close. The 1986 Chernobyl nuclear power plant fallout increased awareness of Poland's destructive reliance on coal, and the realization of the severe environmental damage caused by Soviet troops stationed in Poland, galvanized many more activist groups to form and take action.

Despite their large numbers, Poland's environmental groups still could not achieve any significant results for three reasons. Firstly, Poland's environmental groups consisted mostly of the more wealthy but less numerous professional class. "Volunteer recruitment, a critical aspect of organizational development," describes Glenn E. Curtis, "was hindered by the necessity for many Poles to work two jobs to survive". Secondly, these activist groups could not agree on any common goals. This caused dissension and fragmentation among themselves and allowed for the more unified and organized political parties to receive more attention. Finally, political parties were largely split on the nation's most pressing dilemmas and the majority focused more on economic and social problems than on environmental problems (Curtis, 1994).

6.2.2.1 Polish Ecological Club

The Polish Ecological Club was founded in 1980 in Krakow and is recognized as being the first legally established independent, non-profit, environmental non-government organization in the former Soviet-block countries of Central and Eastern Europe. The Club was the first social organization to openly protest actions taken by a government which treated the environment as an “ownerless, valueless property” and which imposed an energy-intensive economy based on heavy industry. The current Polish Ecological Club is one of eight different groups around Eastern Europe. A three-level structure exists: National (7 full-time/4 part-time employees, volunteers); Regional (14 offices in Poland); Circles/Grassroots (120 smaller groups). The current membership 1995-96 is between 3,000 and 4,000 people as verified by three Annual Congresses held at different locations in Poland.

The main goal of the Polish Ecological Club is “the practical implementation of the true concept of sustainable development; realizing steady improvement in the environmental conditions and the creation of awareness throughout all of society through education that quality of life is dependent on achieving a balance between technological development, humanistic values and wise stewardship of the earth’s natural resources.” (pamphlet from Polish Ecological Club) The Club is a member of several international environmental organizations including; Friends of the Earth International (FOE-I), The World Conservation Union (IWCN), and Environmental Liaison Center International (ELCI). During the past 16 years, the Club has had a major impact on environmental policy in Poland through the following actions:

- publication and distribution of thousands of books and pamphlets promoting environmental education (see Figure 34);
- forcing the closure of a harmful electrolysis division of an aluminum plant outside Krakow;

- major involvement in the formulation of the “Eco-Development” policy which became the official State Environmental Policy adopted by Parliament in 1991;
- successful opposition to the building of several nuclear power plants near the cities of Klempicz and Zarnowiec;
- participation in the creation of the Environmental Impact Assessment Commission by the Ministry of Environment;
- public pressure leading to the closure of a highly-polluting foundry in Siechnice;
- initiation and leadership of numerous successful actions against threats to the cultural heritage of Polish historical sites;
- participation in numerous European-wide programs such the “Action for Protected Areas in Europe,” Air Pollution Project Europe,” and the “CEE Bankwatch Network”;
- ongoing campaign in opposition to the completion of the Mochovce nuclear power plant in neighboring Slovakia

Funding for the Polish Ecological Club is primarily done through fundraising efforts. The Club currently has a three year donation/grant totaling \$180,000 US which they received from the Rockafeller Brothers in New York. They also received an additional \$35,000 US in 1996 from the Charles Stewart Mott Foundation located in Flint, Michigan. United Nations supported grants are also used by the Club for financing their operations. The Club was instrumental in the development and publication of the “List of 80” which contains the names of 80 companies in Poland which are major environmental violators. The list served as a warning to these companies that they will be shut down by the government if they do not reduce pollution emissions and comply with applicable environmental regulations. This marked the first time the role of non-governmental environmental organizations in policy making was officially recognized.

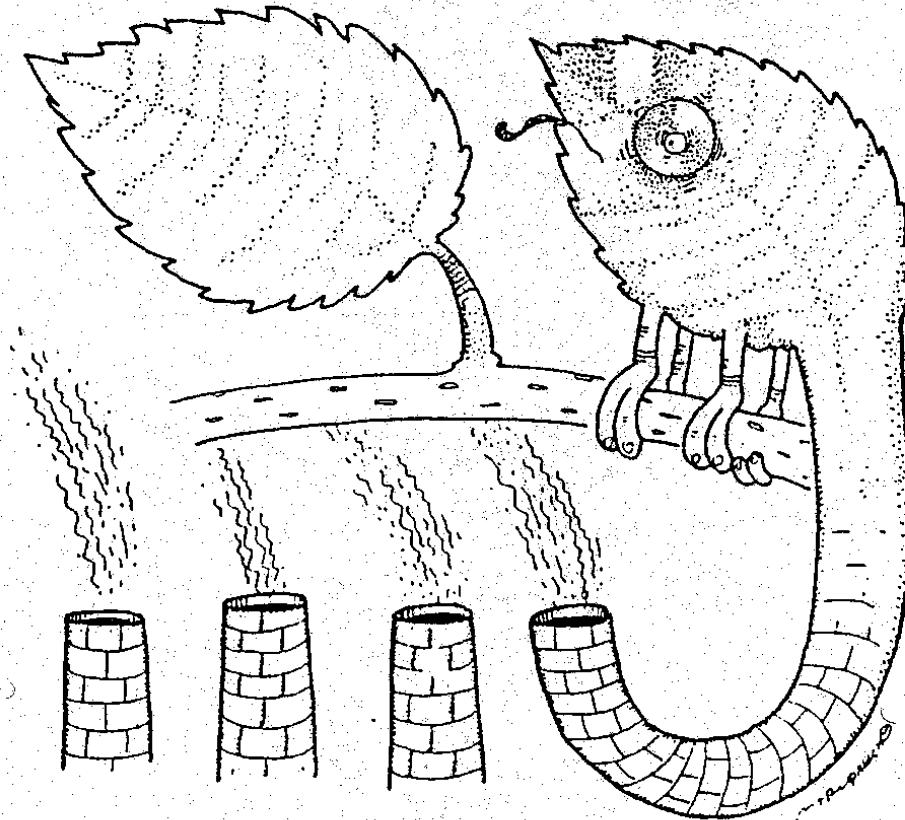
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ZIELONE BRYGADY

PISMO EKOLOGÓW



W NUMERZE M.I.N.:

• Ankieta czytelnicza „Zielonych Brygad”	4
• Kolej - najłatwiej narzekać	4
• Przeciw hipermodernizmowi	50
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Figure 34: Cover of a Pamphlet Published by the Polish Ecological Club

6.2.2.2 The Regional Environmental Education Center in Krakow

The Regional Environmental Education Center is a non-profit, non-governmental organization, founded in 1993 in association with an Environmental Education Group of the Krakow University Branch of the Polish Association for Tourism and Countryside Appreciation (PTTK). The Center is one of 20 regional education centers located throughout Poland. The main mission of the Center is to involve the general public in activities aimed at improving environmental quality and awareness through education. According to members from the Center, “environmental education is not so much about gaining an encyclopedic knowledge of the environment, as influencing the way people relate to the world in which they live and work”

Main projects of the Center include:

- running a Green Library of books, photographs, films, etc.;
- preparing environmental education programs for children from the most polluted areas in Poland.;
- running training courses on environmental education targeted towards teachers;
- coordination of two educational programs which measure acid rain and monitor ozone in schools

Financial support for the Regional Environmental Education Center in Krakow is gained from the following sources:

- The Voivodship Fund for Environmental Protection and Water Management in Krakow
- The Department of Environmental Protection
- The Environmental Partnership for Central Europe - A Project of the German Marshall Fund of the United States
- BUND - Hessen, Germany

- The Regional Environmental Center in Budapest, Hungary
- The Foundation for The Support of Ecological Initiatives in Krakow
- private donors

Overall, the Regional Environmental Education Center in Krakow seems to be succeeding in their goal of education the people, especially the youth, of Poland on issues concerning the environment and their future.

6.2.3 Assistance from the United States

The United States has demonstrated a genuine concern for Poland's environmental conditions. In accordance with the *Support for East European Democracy (SEED) Act of 1989*, the Environmental Protection Agency was given \$10 million to spend on Eastern Europe between 1990 and 1993. Approximately half of this money was spent on Krakow in an effort to improve water quality and air pollution monitoring (Ember, 1990). Furthermore, the US along with other nations have developed a computerized network of pollution monitoring stations in Poland. As mentioned in a previous section, the fixed stations are strategically located to measure the levels and composition of atmospheric poisons from both local and foreign sources.

Numerous capital investments, such as water treatment facilities, and especially training in the areas of environmental management and technology, are examples of productive assistance from the United States. These are essential in establishing the foundations for a sound environmental protection program and promotion of advancement in technology.

7.0 POTENTIAL SITUATIONS OF FUTURE CONFLICT

Discussions with Senior Government officials reveal several situations and/or condition which may contribute to potential situations of future conflict. These include both possible internal and international conflict.

7.1 INTERNAL CONFLICT

The environmentally-friendly Green Party is not a very strong force and currently has no representatives in Congress. The party is not well organized due to the fact that its members are scattered all around Poland. However, when the Polish Senate debates Environmental Issues, members of the Green Party are invited to participate in the discussions. The Green Party, with the support of the Polish Ecological Club, has been instrumental in halting construction of various environmentally-unsafe projects and pushing new legislation through protests.

During the mid 1970's, the Polish government began construction of a nuclear power plant in the city of Zarnowiec using Russian technology. Construction of the plant was halted with only 60% completion due to protesters. After long negotiations, construction resumed with the plant eventually converted to gas operation.

In 1990, construction flaws resulted in the collapse of one of the tallest radio antenna in the world located in the city of Gabin. Local resistance to rebuilding the tower resulted in it not being rebuilt because of concerns about the risks of exposure to electromagnetic radiation.

Today, local residents in the small community of Slupsk, near the Baltic Sea, are in litigation with the Polish military. They are claiming that military radars are sources of harmful electromagnetic radiation.

All of these cases are typical of conditions which have and may contribute to potential situations of future internal conflict.

7.2 INTERNATIONAL CONFLICT

For many decades, Poland was surrounded by only three neighbors: Czechoslovakia; East Germany; and the U.S.S.R. Today, the demise of the Former Soviet Union has resulted in Poland having seven neighboring countries surrounding her borders which include: Germany; Czech Republic; Slovak Republic; Ukraine; Belarus; Lithuania; and Russia. The map in Figure 35 shows the location of these seven countries in relation to Poland. Currently, Poland has to contend with potential international conflicts in the environmental arena with these seven neighboring nations.

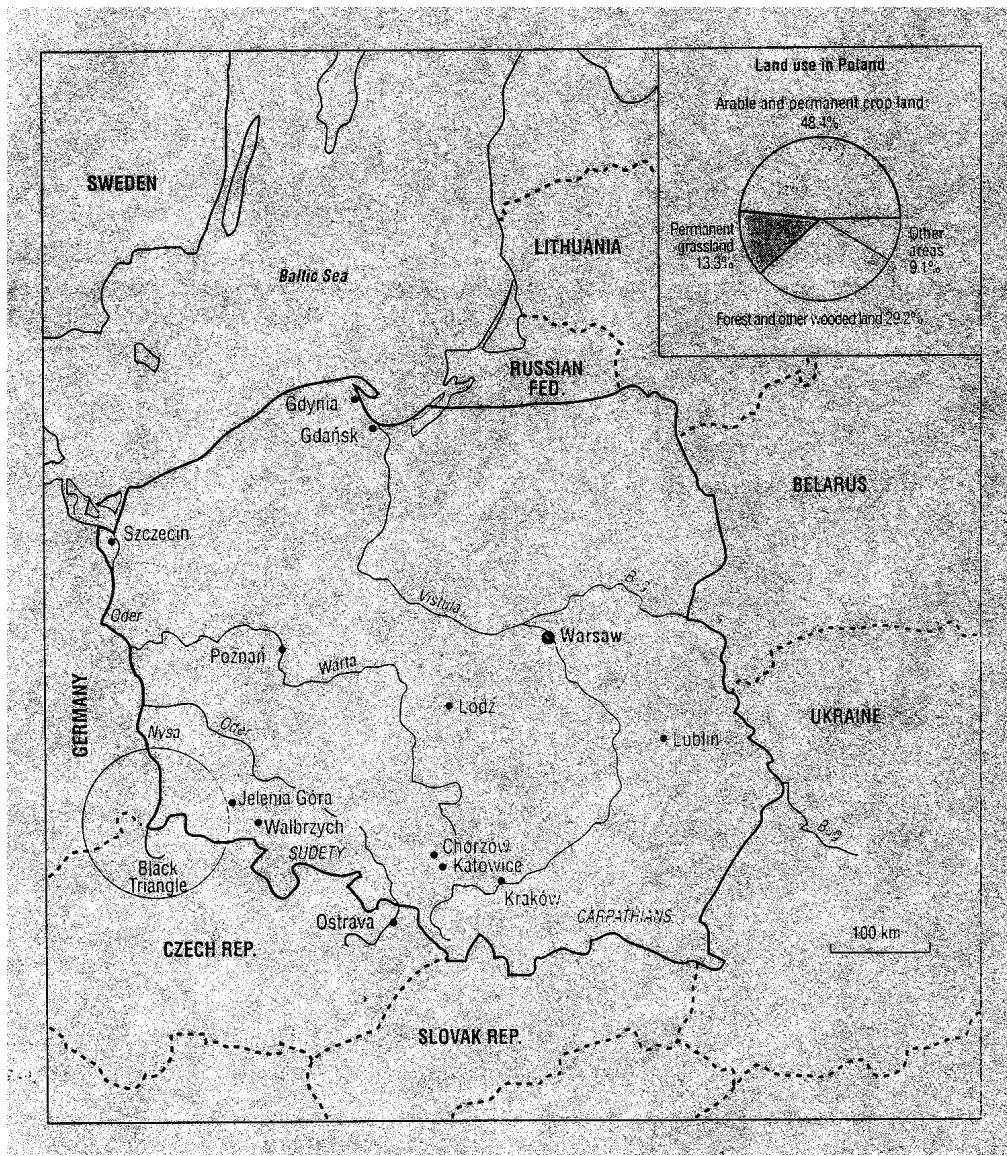
The current relationship with these seven nations has been strengthened through negotiation and implementation of new bilateral agreements concerning water management and pollution, nature protection, and air pollution control. In 1992, a new agreement regarding the protection of “Frontier Waters” was signed with Germany. The main purpose of this agreement was to ensure that pollution control measures would be adopted by both nations with regards to inland waterways, ground water reserves, and emergency response to potential incidences of transfrontier pollution. An intergovernmental agreement signed in 1958 with the Czech and Slovak Republics (then Czechoslovakia) is still binding regarding water management issues. In 1991, Poland was awarded compensation for accidental oil pollution in the Oder River which occurred in 1986. Bilateral agreements were signed with the U.S.S.R. in 1989, and Ukraine in 1994. Currently, cooperation with Lithuania is based on an agreement between the Environment Ministers of Lithuania and Poland. Over time, closer relationships between Poland and its eastern neighbors should develop.

Further discussions with Lt. Col Krzysztof Marszalik, Chief of Environmental Office, were held to gather his perspectives on possible future international conflicts. He presented several examples which are outlined below.

Example #1: The winds tend to prevail from the southwest direction. Many Polish forests are dying as a result of transboundary air pollution coming from Germany and the Czech Republic which both built up their industrial base near the border. Following European standards, forests should cover approximately 30% of the land. In Poland, forests cover 28.5% of the land. Conversely, in Denmark, forests cover only 11% of the land because of pollution transported by westernly winds from the United Kingdom and Germany,

Example #2: Hazardous Waste Dumping in Poland by Germany. Polish Law had gaps in its interpretation and allowed for secondary reuse of resources to be brought to Poland. Today, these laws have been rewritten and now this dumping of waste is highly illegal.

Example #3: Some water pollution comes from Russia transported by the Baltic Sea, however, there are currently no major conflicts between Poland and Russia over this issue.



Source: OECD, 1995

Figure 35: Current Map of Poland and Neighboring Countries

Example #4: There is currently a conflict over the building of a dam between the Slovak Republic and Hungary. This dam would benefit the Slovak Republic, while at the same time be detrimental to Hungary due to potential flooding.

Example #5: Poland has a shortage of drinking water compared to the rest of Europe because of high lead content. No major rivers cross from Poland into other countries, however, water pollution does occur. Petroleum, Oil, and Lubricant (POL) pollution from the Czech Republic is evident in Poland through underground springs. However, this is a very minor and sporadic occurrence.

All of these cases are typical of conditions which have and may contribute to potential situations of future international conflict. As mentioned previously, Poland has signed several bilateral agreements with its neighbors to create commissions to investigate pollution perpetrators and levy appropriate fines. This is a major step in preventing possible international conflicts between neighboring countries over pollution issues.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Since 1989, Poland has undergone major changes in its economic outlook and has made a priority of reconciling economic development with environmental protection (OECD, 1995). Significant environmental improvements have been attained, largely as a result of the adoption of newly created environmental policies and the restructuring of the industrial and energy sectors. Poland has placed high priorities in the battle against pollution of air, water, and soil, along with measures to combat waste management problems. There are even several recycling programs currently in effect. The addition of environmental monitoring programs have proven to be successful in providing a means of collecting valuable data on the environment and assessing current practices.

The building of new infrastructure which includes the Czajka waste water treatment plant, and the landfill site in Warsaw, containing a state of the art biostabilizer, are steps in the positive direction for Poland in its quest to alleviate current environmental problems and prevent future ones from arising. The emergence of research institutes such as the Institute for Ecology of Industrial Areas (IETU) in Katowice provide a forum for researchers to collaborate their efforts in areas of environmental research and development, and the formulation of a scientific basis for national environmental policy makers, etc.

Agencies such as the Ministry of Environmental Protection, Natural Resources and Forestry, have taken responsibility for regulatory duties including the passing of laws governing environment protection. The Ministry also oversees the State Environmental Protection Inspectorate which regulates polluting industries and collects fines from violators. Money collected from these fines are placed in the National Fund for Environmental Protection and Water Resource Management.

Political activist groups such as the Polish Ecological Club are gathering momentum in their pursuit of environmental cleanliness and regulation. External funding from foreign sources have grown considerably over the past decade. Education of environmental issues to the general public has been an ongoing initiative of the Club through the form of books, pamphlets, and awareness presentations.

Internal conflicts have risen with more and more education being available to Poles regarding the environment. Protesters have become increasingly vocal in speaking out against projects, such as the radio antenna in Gabin, which have potentially harmful effects on the environment. The signing of bilateral agreements with its neighboring countries have reduced the threat of international conflicts with Poland regarding environmental pollution. The main purpose of these agreements is to ensure that pollution control measures are adopted by all parties.

Poland has made significant strides in its battle against environmental pollution, however, funding restrictions play a major role in the level of progress it can make. Foreign investment needs to continue for Poland to reach the level of westernized countries, both economically and environmentally.

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APPENDIX A: “LIST OF 80”

POLAND: MAJOR INDUSTRIAL POLLUTERS/SPECIFIC POLLUTANTS RELEASED

In January 1990 Bronislaw Kaminski, the Polish Minister of Environmental Protection, Natural Resources and Forestry released a list of 80 "production enterprises most harmful to the natural environment." These industrial enterprises were selected as a result of an evaluation conducted by the State Inspectorate of Environmental Protection as well as the environmental protection, water management and geology departments of Poland's various voivodships (provinces). The environmentally "most harmful" industrial enterprises were analyzed and selected on the basis of the following criteria: 1) the scale and type of ecological threat posed by the specific enterprise; its consequences for the people and the environment; 2) the extent of the impact of the environmental threat to areas characterized by high population density, significant natural features and favorable conditions for the development of agricultural forestry; and 3) the extent of technical and organizational opportunities for carrying out economic operations in compliance with environmental regulations (see Figure 10). A list and short description of the 80 production enterprises that were considered most harmful to Poland's environment, the province in which they are located, and the pollutants released, follows:

WARSAW CAPITAL CITY

1. Grodzisk Pharmaceutical Enterprise Polfa in Grodzisk Mazowiecki

Heavy pollution of the waters in the Mrowna, Rokitnica, and Ultrata rivers, and pollution of ground waters to a degree which makes it impossible to utilize them in 68 wells located on properties in the immediate vicinity of the enterprise.

UNSPECIFIED POLLUTANTS

2. Warsaw Power and Heating Station Siekierki

Heavy air pollution in the territory of Warsaw, exceeding the maximum permissible concentration of sulfur dioxide and the sedimentation of particulate matter in the area of residential developments. Pollution of the Vistula river. Considerable danger to the population residing in the vicinity of the Zawady waste heaps.

SULFUR DIOXIDE

BIELSKO BIALA

3. Oswiecim Chemical Enterprise in Oswiecim

Prevalent contributor to air pollution in the northeastern part of Bielsko-Biala Voivodship, extends into the territories of Krakow and Katowice Voivodships. Near the enterprise, the permissible concentration of particulate matter is exceeded by a factor of 2, and that of some gases by a factor of 4. The enterprise is a potential source of extraordinary danger to the environment; the waste waters discharged cause the permissible levels of pollution to be exceeded in the Wlosienica river and the quality of water in the Vistula river to deteriorate considerably.

UNSPECIFIED POLLUTANTS

BYDGOSZCZ

4. Janikowo Soda Enterprise in Janikowo

Concentrations of some gaseous and particulate pollutants of the air exceeded severalfold. Ground waters excessively polluted in the area of sedimentation ponds. Water in the Notec river increasingly saline.

UNSPECIFIED POLLUTANTS

5. Organika-Zachem Chemical Enterprise in Bydgoszcz

Heavy pollution of the air by toxic compounds (phenol, formaldehyde, chlorine). Corrosive waste waters discharged into the Vistula river. Soil and groundwater contaminated by stored waste.

PHENOL
FORMALDEHYDE
CHLORINE

CHELM

6. Chelm Cement Mill in Chelm

Continuous pollution of the air with particulate matter affecting neighboring built-up areas, the Chelm Landscape Park, and nature reserves. Stored production waste is a threat to the Bariera and Chelm sub-surface water intakes.

UNSPECIFIED POLLUTANTS

APPENDIX A: "LIST OF 80"

Taken from "Poland's Environmental Characteristics and Requirements: The Application of Environmental Restoration and Waste Management Technologies," October 1991.

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WARSAW CAPITAL CITY

1. Grodzisk Pharmaceutical Enterprise Polfa in Grodzisk Mazowiecki

Heavy pollution of the waters in the Mrowna, Rokiniaca, and Utrata rivers, and pollution of ground waters to a degree which makes it impossible to utilize them in 68 wells located on properties in the immediate vicinity of the enterprise.

UNSPECIFIED POLLUTANTS

2. Warsaw Power and Heating Station Siekierki

Heavy air pollution in the territory of Warsaw, exceeding the maximum permissible concentration of sulfur dioxide and the sedimentation of particulate matter in the area of residential developments. Pollution of the Vistula river. Considerable danger to the population residing in the vicinity of the Zawady waste heaps.

SULFUR DIOXIDE

BIELSKO BIALA

3. Oswiecim Chemical Enterprise in Oswiecim

Prevalent contributor to air pollution in the northeastern part of Bielsko-Biala Voivodship, extends into the territories of Krakow and Katowice Voivodships. Near the enterprise, the permissible concentration of particulate matter is exceeded by a factor of 2, and that of some gases by a factor of 4. The enterprise is a potential source of extraordinary danger to the environment; the waste waters discharged cause the permissible levels of pollution to be exceeded in the Wlosienica river and the quality of water in the Vistula river to deteriorate considerably.

UNSPECIFIED POLLUTANTS

BYDGOSZCZ

4. Janikowo Soda Enterprise in Janikowo

Concentrations of some gaseous and particulate pollutants of the air exceeded severalfold. Ground waters excessively polluted in the area of sedimentation ponds. Water in the Noteć river increasingly saline.

UNSPECIFIED POLLUTANTS

5. Organika-Zachem Chemical Enterprise in Bydgoszcz

Heavy pollution of the air by toxic compounds (phenol, formaldehyde, chlorine). Corrosive waste waters discharged into the Vistula river. Soil and groundwater contaminated by stored waste.

PHENOL
FORMALDEHYDE
CHLORINE

CHELM

6. Chełm Cement Mill in Chełm

Continuous pollution of the air with particulate matter affecting neighboring built-up areas, the Chełm Landscape Park, and nature reserves. Stored production waste is a threat to the Bariera and Chełm sub-surface water intakes.

UNSPECIFIED POLLUTANTS

APPENDIX A: "LIST OF 80" CONT.

Taken from "Poland's Environmental Characteristics and Requirements: The Application of Environmental Restoration and Waste Management Technologies," October 1991.

7. Rejowiec Cement Mill in Rejowiec Fabryczny

The cement mill operates without adequate dust filters; highly burdensome for the adjacent urban and nature areas.

UNSPECIFIED POLLUTANTS

CZESTOCHOWA

8. Rudniki Cement Mill in Rudniki

Permissible norms of particulate matter pollution in urban areas exceeded many times.

UNSPECIFIED POLLUTANTS

9. Kaley Pulp and Paper Enterprise in Kaley

Untreated, critically burdensome pulp and paper waste discharged into the Mala Panew river, caused the complete degradation of water quality.

UNSPECIFIED POLLUTANTS

10. Czestochowa Iron Mill in Czestochowa

Very heavy emissions of particulate matter and gases from this mill endangers the population of Czestochowa and the group of Jurajskie Landscape Parks.

UNSPECIFIED POLLUTANTS

GDANSK

11. Processing and Shipping Enterprise of Chemical Minerals "Siarkopol" in Gdansk

High sulfur emissions cause pronounced acidification of soil and groundwater, as well as the degradation of plants, on a large area adjacent to the enterprise.

SULFUR

12. Gdansk Phosphorus Fertilizer Enterprise in Gdansk

Permissible concentrations of fluorine compounds, sulfur oxides, and sulfuric acid in the air are exceeded many times. Heaps of phosphoric gypsum endanger residential areas and areas under special protection. Pollution of the Gdansk Bay with fluorides and phosphates.

FLUORINE SULFUR OXIDES SULFURIC ACID PHOSPHORIC GYPSUM PHOSPHATES

JELENIA GORA

13. Turow Brown Coal Opencast Mine in Bogatynia

Extensive devastation of the ground surface. Under the influence of the depression funnel, groundwaters have disappeared in the entire area of the Zytawa panhandle. Above-the-norm noise intensity and pollution of water in the Nysa Luzycka and Miedzianka rivers.

UNSPECIFIED POLLUTANTS

14. Turow Power Station in Bogatynia

Excessive pollution of the air by sulfur dioxide, nitrogen oxide, and suspended particulate matter, as well as pollution of the soil by heavy metal compounds. Waste water causes excessive water pollution in the Miedzianka and Rybi Potok rivers.

SULFUR DIOXIDE NITROGEN OXIDE HEAVY METALS

15. Wizow Chemical Enterprise in Boleslawiec

Concentrations of toxic sulfur and fluorine compounds endanger adjacent villages and cause marked degradation of soil and forests. Pollution from the accumulated waste heaps damages soil and groundwaters. Waste water pollutes the Bobr river.

TOXIC SULFUR FLUORINE COMPOUNDS

KATOWICE

16. Hajduki Chemical Enterprise in Chorzow

Waste water is ruining the Rawa river, concentrations of phenols exceeded several dozen times; pollutants from the waste heaps have destroyed the nearby Kalina Reservoir.

PHENOOLS

APPENDIX A: "LIST OF 80" CONT.

Taken from "Poland's Environmental Characteristics and Requirements: The Application of Environmental Restoration and Waste Management Technologies," October 1991.

17. Kosciuszko Iron Mill in Chorzow

Iron mill exceeds permissible concentrations of air pollutants in the densely populated areas of Chorzow.

UNSPECIFIED POLLUTANTS

18. Zabrze Coking Combine-the Knurow Coking Plant in Knurow

Permissible concentrations of highly toxic pollutants exceeded severalfold in densely populated areas. Considerable health risk.

UNSPECIFIED POLLUTANTS

19. Zabrze Coking Combine-the Gliwice Coking Plant in Gliwice

Permissible concentrations of particulate and gaseous pollutants in the air exceeded severalfold in residential areas. Considerable health risk to local population.

UNSPECIFIED POLLUTANTS

20. Metallurgical Combine the Katowice Iron Mill in Dabrowa Gornicza

The largest source of the emission of atmospheric pollution in Katowice area. Emissions of metallurgical particulate matter (including lead and cadmium) and power industry matter (including fluorine and hydrocarbons) causing permissible concentrations of air pollutants to be exceeded over a large area. Excessive amounts of pollutants (including iron and zinc) are discharged into ground and surface waters.

LEAD
CADMIUM
FLUORINE
HYDROCARBONS
IRON
ZINC

21. Nitrogenous Fertilizer Enterprise in Chorzow-Bobrek Carbide Plant in Bytom

Excessive air pollution with gases and particulate matter; in the most ecologically threatened areas of Bytom, permissible concentrations are exceeded several dozen times.

UNSPECIFIED POLLUTANTS

22. Century Cement Mill in Ogródzieniec

Permissible concentrations of highly toxic particulate and gaseous matter in the air exceeded several times.

UNSPECIFIED POLLUTANTS

23. Makoszowy Coking Plant in Zabrze-Makoszowy

Heavy particulate and gaseous air pollution including many particularly harmful toxic substances; permissible concentrations are exceeded several to several dozen times; considerable health risk.

UNSPECIFIED POLLUTANTS

24. Friendship Coking Enterprise in Dabrowa Gornicza

Heavy emission of particulate and gaseous pollutants from coking processes. The discharge of waste water containing excessive quantities of phenols, cyanides, and ammonia nitrogen.

PHENOLS
CYANIDES
AMMONIA

25. Rybnik Power Station in Rybnik

Heavy emission of air pollutants causing the permissible norms of particulate and gaseous emission to be exceeded many times. Transportation and improper storage of waste cause secondary dusting which endangers built-up areas.

UNSPECIFIED POLLUTANTS

26. Laziski Iron Mill in Laziski Gorne

Heavy emission of air pollutants exceeding the permissible norms of concentration of particulate matter and gases. Affects built-up areas and natural environment in large area.

UNSPECIFIED POLLUTANTS

27. Laziski Power Station in Laziski Gorne

Heavy emission of air pollutants exceeding permissible norms of concentration of particulate matter and gases. Affects built-up areas and natural environment in large area.

APPENDIX A: "LIST OF 80" CONT.

Taken from "Poland's Environmental Characteristics and Requirements: The Application of Environmental Restoration and Waste Management Technologies," October 1991.

UNSPECIFIED POLLUTANTS

28. Siersza Power Station in Trzebinia

Heavy emission of air pollutants, exceeding the permissible concentrations of particulate matter and gases. Affects built-up areas and natural environment in a large area.

UNSPECIFIED POLLUTANTS

29. Lagisza Power Station in Bedzin

Excessive emission of air pollutants exceeding permissible concentrations of particulate matter and gases.

UNSPECIFIED POLLUTANTS

30. Jaworzno III Power Station in Jaworzno

Heavy emission of air pollutants exceeding permissible concentrations of particulate matter and gases. Affects build-up areas and natural environment in a large area. Untreated waste water and a waste heap cause dangerous contamination of the Przemysza river.

UNSPECIFIED POLLUTANTS

31. Hard Coal Mine Czeczot in Miedzna Wola

UNSPECIFIED POLLUTANTS

32. Hard Coal Mine Piast in Tychy

UNSPECIFIED POLLUTANTS

33. Hard Coal Mine Ziemowit in Tychy

Mine waters from these mines constitutes the source of catastrophic salinization of the Upper Wisla river which promotes the corrosion of heating, water supply, and sewer installations, water management structures, and river craft; and restricts the use of surface waters for industry, municipal uses, and agriculture.

UNSPECIFIED POLLUTANTS

34. Bobrek Iron Mill in Bytom

Excessive air pollution, permissible concentrations of particulate matter and toxic gases in built-up areas exceeded a dozen or more times.

UNSPECIFIED POLLUTANTS

35. Zinc Smelting Plant Miasteczko Slaskie

Heavy air pollution, permissible concentrations of particulate matter and gases in forested and built-up areas exceeded severalfold. Pollution of the soil with heavy metals, especially lead and cadmium, ruling out agricultural use.

LEAD

CADMIUM

36. Mining and Metallurgical Enterprise Boleslaw in Bukowno

Extremely high pollution of the environment with heavy metals, including lead, zinc, and cadmium. Excessive soil degradation makes agricultural use impossible.

LEAD

ZINC

CADMIUM

37. Organika-Azot Chemical Enterprise in Jaworzno

Corrosive waste water causes marked pollution of surface and groundwaters and soil. Dangerous post-production waste causes considerable contamination of the soil and water, mainly by pesticides.

UNSPECIFIED POLLUTANTS

KIELCE

38. Nowiny Cement and Lime Enterprise in Sitkowka

Excessive air pollution by particulate matter and gases in well-developed urban areas, as well as in local areas under special protection.

UNSPECIFIED POLLUTANTS

KONIN

39. Aluminium Smelting Plant Konin in Konin

Heavy air pollution, water, and soil by highly toxic fluorine compounds in the area of the city of Konin and nearby settlements and villages. Waste water causes the quality of water in the Warta river to deteriorate in the area of Konin water intake.

FLUORINE

APPENDIX A: "LIST OF 80" CONT.

Taken from "Poland's Environmental Characteristics and Requirements: The Application of Environmental Restoration and Waste Management Technologies," October 1991.

40. Konin Power Station in Konin

Sizable emission of particulate matter and gaseous pollutants. Discharge of heated water and waste water to Patniew Lake causing its eutrophication.

UNSPECIFIED POLLUTANTS

KRAKOW

41. Krakow Soda Plant in Krakow

Soda plant causes atmospheric pollution in the largest residential development of Krakow. Chlorine compounds contained in raw sewage and bleached from sedimentation ponds adjacent to the plant constitute a significant source of pollution for the Vistula and Wilga rivers.

CHLORINE COMPOUNDS

42. Metallurgical Combine Lenin Iron Mill in Krakow

One of the most excessive and burdensome sources of air pollution throughout the country; poses an exceptional danger for the people and monuments of Krakow, as well as agriculture and natural environment.

UNSPECIFIED POLLUTANTS

43. Krakow Pharmaceutical Enterprise Polfa in Krakow

Excessive emission of gaseous pollutants, especially aromatic hydrocarbons, affects the immediately adjacent residential areas and groups of monuments in Krakow.

AROMATIC HYDROCARBONS

LEGNICA

44. Mining and Metallurgical Combine Copper Metallurgical Plant in Legnica

Heavy pollution of the environment with toxic gases and particulate matter, including highly toxic compounds of heavy metals. Danger to the health of the people of Legnica and adjacent forests and farmland.

HEAVY METALS

45. Mining and Metallurgical Combine Copper Metallurgical Plant Glogow I in Glogow

High rate of emission of particulate and gaseous pollutants. Considerable area of flotation waste storage causing the pollution of air, soil, and water. Deterioration of farmland and forest land.

UNSPECIFIED POLLUTANTS

LUBLIN

46. Truck Works in Lublin

Excessive air pollution, permissible concentration of particulate matter and gases in densely populated areas exceeded many times. Waste water pollutes surface waters.

UNSPECIFIED POLLUTANTS

47. Nitrogenous Fertilizer Plant in Pulawy

High emission of particulate matter and gases causes soils and plants to deteriorate in large

areas, including those under special protection. 8,000 hectares of forest stands destroyed.

UNSPECIFIED POLLUTANTS

LODZ

48. Dies Industry Enterprise Buruta in Zgierz

Heavy air pollution with particularly toxic compounds exceeding permissible norms. Extremely corrosive raw sewage ruins water in the Bzura river.

UNSPECIFIED POLLUTANTS

49. Polonit Enterprises for Seals and Asbestos Products in Lodz, Enterprise B

Excessive and burdensome pollution by toxic substances (gasoline solvent) and particulate matter containing asbestos. Noise intensity in residential areas exceeds permissible norms.

GASOLINE SOLVENTS ASBESTOS

NOWY SACZ

50. Sacz Electrical Coal Processing Enterprises in Nowy Sacz

Heavy pollution with hydrocarbons in densely populated areas and areas under special environmental protection.

HYDROCARBONS

APPENDIX A: "LIST OF 80" CONT.

Taken from "Poland's Environmental Characteristics and Requirements: The Application of Environmental Restoration and Waste Management Technologies," October 1991.

OPOLE

51. Coking Enterprise of the Silesian Insurgents in Zdzieszowice

Excessive and burdensome air pollution by toxic gases and particulate matter in heavily populated areas. Considerable health risk.

UNSPECIFIED POLLUTANTS

52. Blachownia Chemical Enterprise in Kedzierzyn-Kozle

Heavy air pollution, exceeding permissible concentrations of gaseous pollutants, including toxic substances. Dangerous waste accumulated in considerable quantities endangers local ground and surface water purity.

UNSPECIFIED POLLUTANTS

53. Kedzierzyn Nitrogenous Fertilizer in Kedzierzyn-Kozle

Heavy emission of particulate and gaseous pollutants, in particular ammonia, causes nearby forests and soil to deteriorate. A considerable source of pollution in the Odra river.

AMMONIA

OSTROLEKA

54. Ostroleka Pulp and Paper Enterprise in Ostroleka

Permissible concentrations of particulate pollutants and malodorous gases exceeded many times. Waste water causes

considerable water pollution in the Narew river. Improperly stored waste endangers groundwater.

UNSPECIFIED POLLUTANTS

PIOTRKOW

55. The Belchatow Power Station in Rogowiec

Greatest emission of gaseous pollution in the country. Marked deterioration of a large area of forests. Waste storage causes increase in groundwater pollution.

UNSPECIFIED POLLUTANTS

56. The Belchatow Brown Coal Opencast Mine in Belchatow

Ground surface disturbed over a large area; extensive depression funnel formed which causes the disappearance of water in shallow water intakes, drying the soil and ground subsidence. Farmland and forests endangered.

UNSPECIFIED POLLUTANTS

57. Wistom Chemical Fiber Plant in Tomaszow Mazowiecki

Heavy emission of hydrogen sulfide, carbon disulfide, and sulfur dioxide damages build-up areas. One of the main sources of pollution in the Pilica river.

HYDROGEN SULFIDE

CARBON DISULFIDE

SULFUR DIOXIDE

PLOCK

58. Mazowsze Refinery and Petrochemical Enterprise in Plock

Above-the-norm particulate and gaseous air pollution with toxic substances in well developed urban areas. This facility is one of the main sources of pollution of the middle reaches of the Vistula river.

UNSPECIFIED POLLUTANTS

POZNAN

59. Poznan Chemical Enterprise in Lubon

High emission of gaseous pollutants, including fluorine and suspensions of sulfuric acids and sulfur dioxide. The contamination of the soil and groundwater in the area of the dumping ground by very harmful post-production waste. Pollution of the Warta river and deterioration of the environment in the Great Poland National Park.

FLUORINE

SULFURIC ACID

SULFUR DIOXIDE

RZESZOW

60. Rzeszow Enterprise of Vapor Lamps Polam-Rzeszow in Podgzwizdow Nowy

The waste containing mercury and stored in the compound of the plant causes the contamination of the soil and groundwater, as well as the emission of mercury into the air.

MERCURY

APPENDIX A: "LIST OF 80" CONT.

Taken from "Poland's Environmental Characteristics and Requirements: The Application of Environmental Restoration and Waste Management Technologies," October 1991.

SKIERNIEWICE

61. Chodakow Chemical Fiber Enterprise Chemitek in Sochaczew

Permissible concentrations of carbon disulfide in the air in residential areas and in the Kampinos National Park are exceeded severalfold. The waste waters pollute the Ulata and Bzura rivers.

CARBON DISULFIDE

SZCZECIN

62. Police Chemical Enterprise in Police

High emission of particulate matter and gases into the air, including ammonia and sulfuric acid. Inadequately treated waste causes the quality of water in the Odra river to deteriorate. Strip phosphorous gypsum storage constitutes a potential source of environmental danger.

AMMONIA

SULFURIC ACID

PHOSPHOROUS GYPSUM

63. Chemical Fiber Enterprise Chemitek Wiskord in Szczecin

Considerable emission of hydrogen sulfide and carbon disulfide causes permissible concentrations to be exceeded in built-up areas and areas under special environmental protection. Ground and surface waters polluted by acidic sewage containing zinc.

HYDROGEN SULFIDE

CARBON DISULFIDE

ZINC

TARNOBRZEG

64. Siarkopol Mine and Sulfur Processing Enterprise in Tarnobrzeg

Air polluted by toxic gaseous compounds. Waste waters have completely ruined the Mokrzyszczowka and Trzesniowka rivers and are a significant source of pollution of the Wislula river.

UNSPECIFIED POLLUTANTS

65. T. Kosciuszko Power Station in Polaniec

High emission of sulfur dioxide, nitrogen oxides, and particulate matter into the air. Degradation of soil in ash storage area.

SULFUR DIOXIDE

NITROGEN OXIDE

66. Stakowa Wola Power Station in Stakowa Wola

High emission of sulfur dioxide and particulate matter into the air in a well-developed urban area. Degradation of soil around ash storage area.

SULFUR DIOXIDE

67. Mine and Sulfur Chemistry Enterprise Siarkopol in Grzybow

Excessive emission of toxic particulate and gaseous pollutants. Pronounced soil degradation. Waste water pollutes the water in the Czarna Staszowska and Wschodnia rivers.

UNSPECIFIED POLLUTANTS

TARNOW

68. Nitrogenous Fertilizer Enterprise in Tarnow

High emission of toxic substances into the air poses ecological threat to Tarnow. Polluted waste waters destroy water quality in the Biala and Dunajec rivers.

UNSPECIFIED POLLUTANTS

69. ERG Plastics Enterprises in Pustkow

Heavy emissions of phenol and formaldehyde into the air and water. Pollution of the Wislota river with formaldehyde.

PHENOLS

FORMALDEHYDE

70. Niedomice Pulp Enterprise in Niedomice

Water in the Zabnica and Bren rivers destroyed by untreated waste; groundwaters in the tributary areas of these rivers are polluted. Permissible concentrations of gaseous compounds in the air exceeded.

UNSPECIFIED POLLUTANTS

TORUN

71. Torun Enterprises of Non-Organic Industry Polchem in Torun

High concentrations of sulfur dioxide. A potential source of extreme environmental threat. A considerable source of pollution in the Vislula river.

APPENDIX A: "LIST OF 80" CONT.

Taken from "Poland's Environmental Characteristics and Requirements: The Application of Environmental Restoration and Waste Management Technologies," October 1991.

SULFUR DIOXIDE

WALBRZYCH

72. Walbrzych Coking Enterprise in Walbrzych

Permissible concentrations of particulate and gaseous pollutants in the air, including highly toxic compounds, are exceeded severalfold in the residential areas. Considerable health risk. Contamination of underground water by the toxic tar waste storage site.

TOXIC TAR

73. Power and Heating Station Victoria in Walbrzych

High emission of particulate matter and gases in a densely populated area (Walbrzych) and an area under special environmental protection (Szczawno-Zdroj).

UNSPECIFIED POLLUTANTS WLOCLAWEK

74. Pulp and Paper Enterprise in Włodawek

Considerable source of pollution in the Vistula river due to insufficiently treated production waste. Permissible concentrations of sulfur dioxide exceeded in a densely populated area; emission of malodorous compounds into the air.

SULFUR DIOXIDE

75. Nitrogenous Fertilizer Plant in Włocławek

Emission of considerable amounts of oxides, sulfur dioxide, ammonia, vinyl chloride, and particles of polivinylchloride creates difficulties for the citizens of Włocławek.

SULFUR DIOXIDE

AMMONIA

VINYL CHLORIDE

POLIVINYLCHLORIDE

WROCŁAW

76. Odra Enterprise of Organic Industry Organika-Rokita in Brzeg Dolny

High emissions of toxic substances into the atmosphere: phenol, chlorphenol, benzene, and hydrogen sulfide. Permissible concentrations of phenols in the air exceeded several times. Deterioration of the Odra river as a result of inadequate treatment of the waste. Excessive concentration of mercury in the soil in the vicinity of the industrial facility.

PHENOL

CHLORPHENOL

BENZENE

HYDROGEN SULFIDE

MERCURY

77. Hutnica Metallurgical and Processing Enterprise for Non-Ferrous Metals in Wrocław

Permissible concentrations of particulate matter, zinc, and lead in the air in urban area exceeded. Contamination of the soil and

groundwater in the area of the enterprise and in and around the waste site.

ZINC

LEAD

78. Viscoplast Chemical Enterprise in Wrocław

Permissible concentrations of sulfur dioxide in the inhabited area affected by the plant have been exceeded. Pollution of Odra river by heavy metals due to the insufficient treatment of waste waters. Pollution of the soil in the vicinity of the waste storage areas.

SULFUR DIOXIDE HEAVY METALS

79. Olawa Metallurgical Enterprise in Olawa

Considerable emission of particulate matter containing heavy metals into the air causes pronounced contamination of the environment with lead, zinc, and cadmium in the urban areas around the plant.

LEAD

ZINC

CADMIUM

80. Siechnice Metallurgical Enterprise in Siechnice

The heap of metallurgical slag created by the metallurgical plant poses a threat to the water intake for Wrocław.

UNSPECIFIED POLLUTANTS

APPENDIX B: LIST OF ENVIRONMENTAL INSTITUTIONS IN POLAND

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**Ministry of Environmental Protection,
Natural Resources and Forestry**
ul. Wawelska 52/54,
00-922 Warszawa, Polska
tel: 625 00 01
Stanislaw Zelichowski, Minister of Environment
Col. Andrzej Solomacha, Director

**Ministry of National Defense, Department of
Social Relations**
ul. Krolewska 2,
00-909 Warszawa, Polska
tel: 687 31 75
Lt. Col Krzysztof Marszalik, Chief of
Environmental Office

Institute of Environmental Protection
ul. Kruca 5/11,
00-584 Warszawa, Polska
tel: 625 10 05
Pawel Blaszczyk, Director

Institute of Forestry Research
Skryt. Poczt. 61,
00-973 Warszawa, Polska
tel: 622 32 01

**Research Center for Protection of Nature and
Natural Resources, Polish Academy of
Sciences**
ul. Lubicz 46,
31-572 Krakow, Polska
tel: 21 51 44

**Institute of Environmental Engineering,
Polish Academy of Sciences**
ul. Curie-Sklodowskiej 34,
41-800 Zabrze, Polska
tel: 03 64 01

**Senate of the Republic of Poland,
Environmental Protection Committee**
ul. Wiejska 6,
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